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PSYCHOSOMATIC MEDICINE—VOL. III, NO. 2, APRIL, 1941

# BIOLOGY OF DRIVES

CURT P. RICHTER, PH.D.*

THIS DISCUSSION of drives rests on a discovery made many years ago, in 1859, by the great French physiologist, Claude Bernard, (*1*). He was the first one to speak of a constant internal environment—an optimal environment for the habitat of living cells. He showed that in animals the body fluids which constitute the internal environment must have a fairly constant mineral content, acid-base relationship, temperature, etc., and that even small deviations from the fixed levels might threaten life. In normal individuals the body meets such threats with mechanisms which serve to restore the various functions to their fixed levels. Thus, when the body is exposed to a cold external environment which threatens to lower the body temperature, decreased sweating reduces heat loss, while burning of fat, shivering, etc., increase heat production. Many other well known instances of self-regulation could be cited. Haldane stated that Bernard's concept of the constant internal environment was the most important advance in modern medicine (*5*). Cannon greatly elaborated this concept and spoke of a steady state, or homeostasis. The results of his studies are summarized in his well known book, "The Wisdom of the Body" (*3*).

Bernard and Cannon dealt largely with the physiological regulators—responses of individual organs or systems—which serve to maintain a constant internal environment. Several years ago we found that the organism itself, the total organism, may also play an important part.

In the intact organism these total responses are apt to be overlooked or regarded simply as reactions to various external stimuli. It was not until we were able to eliminate the physiological regulators, or part responses, in experimental animals, that we obtained a clear view of the total organism responses which serve to maintain a constant internal environment. A few examples should suffice to illustrate this point.

The first example concerns the maintenance of the internal water balance. In the intact organism we know that the regulation of the water balance depends largely on the anti-diuretic secretion from the posterior lobe of the pituitary gland. When the organism is threatened with dehydration, the gland secretes more anti-diuretic hormone. As a result, the kidney excretes less urine; and consequently, less water is lost from the body. When the body has an oversupply of water, the gland secretes less anti-diuretic hormone, the kidney excretes more urine, and more water is lost. Surgical removal of the posterior lobe thus eliminates the most important part of the physiological means of regulating the internal water balance. When not given access to water, animals deprived of their posterior lobes lost as much as one-sixth of their weight in less than eight hours after posterior lobectomy and, as a result, died much sooner than normal animals deprived of water. If given access to water, they drank very large amounts and, as a result, kept themselves alive and in good health indefinitely. Some of the rats drank almost twice their weight in water every day. In this condition we must regard the high water intake, the polydipsia, not

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as a pathological symptom but as an effort made by the whole organism to maintain a constant internal environment. Many clinicians and experimental workers still regard the polydipsia of diabetes insipidus as an isolated phenomenon which results from a brain injury and bears no relation to the total organism. It is clear, however, that after the physiological means of regulating water metabolism has been removed the organism itself makes an effort to maintain a constant internal environment by drinking large amounts of water (*7*).

The next example concerns the maintenance of a constant body temperature. In the intact organism we know that the regulation of body temperature depends to a large extent on the secretions from the pituitary and thyroid glands. After removal of either one of these glands, the rate of metabolism decreases and body temperature falls. If such an animal is kept even in only a slightly cooled room, its body temperature will soon fall below the level compatible with life. Given the opportunity, such an animal will make an effort to conserve heat and maintain normal body temperature by covering itself with large amounts of nesting material. This we were able to demonstrate experimentally and with quantitative methods. The cage used for these experiments contained a food cup, a water bottle, and a roll of soft tissue paper, ½ inch wide and 500 feet long. The end of the roll of paper was introduced through a glass tube which projected about 3 inches into the cage. The paper hung freely from the end of this tube and within easy reach of the rat. The amount of paper pulled into the cage was recorded by a cyclometer, using a scale to determine the length of paper per revolution with relation to the changing diameter of the roll. All of the paper pulled into the cage was removed each day at noon. It was found that normal rats, males and females alike, will build nests every day, even though each day all of the nest paper is taken away. The amount of paper used increases in cold temperatures and decreases in warm temperatures. After removal of the pituitary gland, the rats build very large nests, even at ordinary room temperature. Some of the hypophysectomized rats used the entire roll each day. After removal of the thyroid gland, the rats build equally large nests (*8*).

Thus, we have here another instance in which, after the physiological means of maintaining a constant internal environment ceases to function, the animal itself makes an effort to attain this end.

The third example concerns the maintenance of constant mineral, carbohydrate, and fat levels in the blood stream. It is a well known fact that the adrenal glands regulate sodium metabolism. In rats, when these glands are removed, sodium leaves the body in the urine in excessively large amounts, upsetting the internal sodium balance so much that death follows in a few days. When sodium chloride is supplied either in the food or by injection as rapidly as it leaves the body, these animals can be kept alive and free from symptoms of insufficiency. At this point our research began. We were interested to know whether, when adrenalectomized rats are given access to sodium chloride in a container separate from their food, they will voluntarily take sufficiently large amounts to keep themselves alive and free from symptoms of insufficiency. For this purpose we used a very simple cage which contained a food cup and two graduated inverted bottles, one filled with tap water, the other with a 3 per cent solution of sodium chloride. The food contained no sodium chloride. Records were made daily of

the intake from the two bottles. Adrenalectomy was not performed until the intake from each bottle had reached a fairly constant level. Almost immediately after operation, in some instances within a few hours, the rats began to drink more of the salt solution; and after several weeks they drank 10 to 15 times as much per day as they had before. As a result, they survived without loss of weight or symptoms of insufficiency. The significance of these findings is emphasized by the fact that 100 per cent of the adrenalectomized rats die when kept on a sodium chloride free diet, while 100 per cent of those on such a diet with access to sodium chloride solution survive. Adrenal implants made to the anterior chamber of the eye cause the sodium chloride appetite to decrease to its normal level again (*9*).

Similar observations were made on parathyroidectomized rats. Biochemical and clinical studies have established the fact that the parathyroid glands regulate calcium and phosphorous metabolism. After removal of these glands, the calcium level of the blood falls, and the phosphorous level rises. Rats quickly develop tetany and usually die within a few days. We were interested to know whether, after the physiological means of regulating the calcium metabolism had been removed, the rats themselves would make an effort to maintain a constant calcium balance. The same cages were used as in the experiments with adrenalectomized rats. Each rat had access to a calcium free diet and two bottles, one filled with water, the other with a 2.4 per cent solution of calcium lactate. Parathyroidectomy quite regularly increases the calcium lactate intake far above the normal levels. Some of the rats drank 20 times as much of the calcium lactate solution as they had before. Parathyroid implants made to the anterior chamber of the eye caused the calcium appetite to decrease to its normal level again. These rats showed an increased appetite for other calcium salts—the acetate, nitrate, and gluconate—but not for the salts of other metals, with the exception of strontium and magnesium, both of which are closely related to calcium and both of which have ameliorative effects on clinical parathyroid tetany (*10*).

Similar observations have been made on the regulation of the carbohydrate and fat metabolism of pancreatectomized rats. Biochemical and clinical studies have shown that the pancreatic secretion of insulin plays an important part in the metabolism of carbohydrates. Without insulin the blood sugar increases, the weight decreases, polyuria and polydipsia set in. Rats made diabetic by pancreatectomy were given access to a fat (olive oil), a carbohydrate (sucrose), a protein (casein), and various minerals and vitamins in separate containers. On the selections made from this assortment of substances, stock rats show normal growth and reproduction (*11*). The pancreatectomized rats, which on the standard McCollum diet had for several months shown all the symptoms of diabetes, were put into multiple food choice cages. These rats ingested large amounts of the olive oil and little or none of the sucrose and took large amounts of casein and yeast. As a result of these choices, the rats gained weight, lost their polydipsia and polyuria, and their blood sugar decreased. When they were returned to the McCollum diet, which forced them to take the fat, carbohydrate, and protein in certain fixed proportions, all of the diabetic symptoms promptly reappeared (*12*).

The results of the experiments described above establish the fact that, after the physiological means of maintaining a constant internal environment have been removed, the organism

itself makes an effort to attain this end. We may conclude either that the behavior factors take over only after the physiological factors have been eliminated or that in the intact organism they both must function more or less at the same time. In all probability the latter conclusion gives the most accurate description of this situation.

That the behavior factors play an important part in the intact organism is shown by nutritional experiments made on normal rats. We found that these rats made advantageous selections from as many as 15 different substances—all offered in purified (or nearly purified) form—one fat, one protein, one carbohydrate, five minerals, members of the vitamin B complex, and vitamins A and D. On their selections the rats grew as well as on the McCollum diet although they ate from 15 to 40 per cent less food per day as measured in grams (unpublished data).

This knowledge of the close relationship between dietary selections made by animals and their internal needs offers us a new tool for the investigation of many phases of nutrition. Had this method been available, we could have established many years ago—long before the advent of modern biochemical methods—that the adrenal glands are concerned with the regulation of sodium metabolism. It would only have been necessary to place an adrenalectomized rat in a cage containing a variety of mineral solutions in different containers. Likewise, we could have discovered the calcium regulatory function of the parathyroids, etc. This method applied to the study of vitamin B deficient rats has already uncovered needs not previously detected by biochemical methods.

The question arises: how are the rats able to make such wise and advantageous dietary selections? There are two obvious possibilities—1) the rats sample the different foods and eat the one which makes them feel better (in other words, the dietary selections are made on the basis of previous experience or conditioning), and 2) they depend primarily on taste and are independent of experience. For example, in an adrenalectomized rat all the tissues of the body have a sodium deficiency, including the taste buds of the tongue. When sodium chloride comes in contact with the tongue in adrenalectomized rats, it produces quite different reactions than in a normal animal. It may even have a different taste. Evidence for this view comes from the following experiment in which normal rats were offered a choice between distilled water and varying concentrations of sodium chloride solution. They first recognized a difference between the water and the salt solution in a concentration of 1 part of salt to 2000 parts of water. Under the same circumstances adrenalectomized rats recognized the difference in a concentration of 1 part of salt to 33,000 parts of water (*13*).

Further evidence for this view came from the observation that adrenalectomized rats in which the taste nerves had been sectioned no longer showed an increased appetite for salt and, as a result, died within a few days (*14*).

In the normal intact organism we do not know the relative importance of the rôles played by the physiological and behavior factors. It is conceivable that the relationship might be something like this. For example, an animal with defective adrenal cortex, and hence lacking in the sodium regulatory hormone, may compensate for the abnormal salt loss by increasing its salt intake, while an animal with overactive adrenals could decrease its salt intake. On the other hand, in an animal living in a region which offers little or no salt the adrenals might become overactive and thus conserve salt—or in animals which are forced to eat exceedingly large amounts of salt the adrenals might

atrophy and thus allow the elimination of more salt.

Thus far we have not made many comparable observations under experimental conditions on human beings. We have, however, observed many instances of salt craving in patients with Addison's disease and in other conditions involving a partial or total destruction of the adrenal cortex. One such patient, a $3\frac{1}{2}$-year-old boy, who was brought to the hospital for precocious sex development was described in collaboration with Dr. Lawson Wilkins (*19*).

While under observation primarily for the endocrine studies of his sex development, this boy was put on a regular ward diet which included the normal amount of salt. He died unexpectedly, in 7 days. At autopsy it was found that the greatly hypertrophied sex zone of the adrenals had obliterated the cortex. Just before leaving for home the mother remarked that the boy had shown a marked craving for salt. In response to a few simple questions we received an 8-page letter which is a most interesting behavior document.

During the first year the child had presented a serious feeding problem until it was found by chance that he liked salt on crackers, and later plain salt. On the local doctor's advice he was permitted all the salt he wanted. He ate it literally by the handful, enjoying it as other children do sugar. When at the age of $3\frac{1}{2}$ he was brought to the hospital and placed on an ordinary diet without access to extra salt, he quickly developed deficiency symptoms and died. He had kept himself alive previous to this time exactly the way adrenalectomized rats do. We have records of patients with Addison's disease who crave salty soups, salty ham, and one patient who regularly robbed the juice from the sauerkraut barrel. A patient who came to the hospital last fall took about half a glass of salt with his tomato juice and put salt on grapefruit, oranges, and lemons.

Undoubtedly, most of the instances of peculiar appetites will be found to have a dietary significance.

Dr. Clara Davis (*4*) demonstrated some years ago that young children, given free access to a variety of natural foods, will make selections which result in normal growth and development. This same observation had previously been made at agricultural stations in feeding cattle. However, when natural foods are used the results are confused by the numerous ingredients; and it cannot be determined which one of the various ingredients is sought. It is now possible to offer selections made from strictly purified substances, even the crystalline members of the vitamin B complex.

The reason that human beings often make faulty dietary choices may be explained in part by parental guidance and by advertisement. Often when a child expresses a great appetite for certain substances, he is told by his parents that he must not eat them; equally often he is told to eat things which are very distasteful to him. He quickly learns to distrust his own appetite; and when he comes under the influence of advertisements, he falls prey to them.

Actual defects in the gustatory apparatus—the tongue, the taste nerves, or the cortical areas of the brain—may also account for faulty choices. Salmon and Blakeslee (*18*) found that about 3 out of 100 individuals are at least partly taste blind to a bitter substance, phenylthiocarbamide. Their lack of ability to taste this substance is inherited on a Mendelian basis as a recessive (*2*). We have found individuals who could not recognize a 10 per cent solution of sucrose (*15*).

Finally, it may be asked, "How can these principles be applied to the study of abnormal or psychotic behavior?"

It would be interesting to know to what extent various manifestations of abnormal behavior can be understood as an effort to maintain a constant internal environment or in terms of a breakdown at some point of the mechanisms involved in the maintenance of a constant internal environment. For example, we may consider the conditions of marked overactivity and underactivity. Overactivity may be regarded as an effort to burn sugar or other energy producing substances present in dangerously large amounts in the organism. Only marked activity may help to keep these substances within the limits compatible with life. The play activity of the child may thus be regarded, in part at least, as an effort to maintain a constant internal environment.

On the other hand, we may consider overactivity as the result of a breakdown of some part of the adjusting mechanism. For instance, we have found that in rats, cats, and monkeys removal of a small part of the frontal poles of the brain may produce a state of great overactivity. Some rats from which only the tips of the frontal poles had been removed ran over 48 miles in 24 hours (*16*). Some of our cats literally ran themselves to death (*6*). Monkeys with areas 9 and 10 removed became markedly overactive (*17*).

Underactivity we may regard in the first instance as an effort to conserve energy or in some other way to maintain a constant internal environment. However, it may be considered as the result of a break-down of the mechanism which helps to maintain a constant internal environment, such as would result from a brain or brain stem injury, defective sensory equipment, etc.

Thus, in summary, it has been shown that the effort to maintain a constant internal environment constitutes one of the most universal of all behavior drives. Exaggerated forms of behavior are ordinarily spoken of as drives, and a motive power is assumed largely by implication. In the effort to maintain a constant internal environment we see for the first time the real motive power, the energy behind behavior drives.

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# THE FRONTAL LOBES AND CONSCIOUSNESS OF THE SELF

WALTER FREEMAN, M.D. AND JAMES W. WATTS, M.D.*

THE FRONTAL LOBES have been under recurrent scientific investigation since the time of Gall and Spurzheim, but particularly so since the first World War. After the conflict, large numbers of healthy young men who had suffered penetrating wounds of one or both frontal lobes were available for study, and could be compared with others who had been injured in other parts of the brain. Feuchtwanger (*4*), Kleist (*7*), and Goldstein (*5*), have given us several profound studies. This war material was open to objection, however, on account of the shattering effects on the brain of high-speed projectiles. More satisfactory observations later came into prominence following the frontal lobectomies, both unilateral and bilateral, beginning with Dandy's case (1930), later reported by Brickner (*2*). Rylander (*10*) wrote a fine monograph on the basis of 32 unilateral cases from Olivecrona's Clinic. Nevertheless, there has been no uniformity of opinion as regards the functions of the frontal lobes, and there are scarcely two individual investigators who have been able to describe in similar terms the mechanisms underlying the behavior of patients following removal of significant amounts of frontal lobe tissue. It was only following the pioneer observations of Egas Moniz (*3*), who was able to relieve certain patients of mental symptoms by a destructive operation carried out upon their frontal lobes, that renewed study of the whole question brought to light a number of points of view that had previously been neglected. Aside from the rather transcendental ideas put forth by Goldstein and by Kleist, (the latter linked them rather romantically with the Brodmann chart of cortical architecture), most of the studies[1] focused their attention upon the intellectual functions since these were supposed to be mediated by the frontal lobes. However, the works of Brickner and of Rylander showed rather conclusively that defects in intelligence as ordinarily measured were not sufficient to explain the behavioral difficulties that the patients suffered following prefrontal lobectomy. Furthermore, while these and other authors discussed at length the functions of the frontal lobes, they were in the main describing the behavioral adaptations of individuals, presumably previously normal, who through injury and disease, had been deprived of an important part of their functioning cerebral structure.

We believe that there are inherent defects in the lobectomy material. While a clean-cut lobectomy permits of a splendid localization of the lesion, nevertheless the preexisting cerebral disturbance, whether it was due to abscess, tumor, scar, or whatnot, must have brought about a sufficiently severe derangement of the cerebral functioning to require operation, and further-

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[1] A relatively complete bibliography will be found in the authors' monograph "Psychosurgery. Intellect, Emotion and Social Behavior Following Prefrontal Lobotomy in the Treatment of Mental Disorders." Charles C Thomas, Springfield, 1941. (In Press.)

more it was by no means certain that the injury had been limited to the part removed. Finally, these operations occurred mostly in individuals who previous to the injury or disease had been for the most part normally adapted in society, able to handle their frustrations without too much difficulty, and showing a normal balance of their attention between inwardly and outwardly directed interests.

The procedure of Egas Moniz, as modified by us and by other investigators, has thrown a flood of new light upon the functioning of the frontal lobes. Aside from the purely therapeutic effects of the operation, the procedure meets the requirements of the perfect experiment. The brain is anatomically normal to begin with. There is no significant trauma or shock. The incisions are simple, clean-cut, and almost bloodless, and can be located exactly. The patient is encouraged to talk throughout the operation, and tests of various sorts can be run both before and at intervals following operation. So much for the operation. As far as the patients are concerned, we are dealing with individuals who show various abnormalities of thinking, feeling, and behavior, and we can study the alterations that occur in such activities as the result of operation. The study of such cases presents a number of points of interest to the student of psychosomatic relationships.

In a number of previous publications, we have discussed the various aspects of personality that are altered by the operation of prefrontal lobotomy. We have erected the hypothesis that the frontal lobes are concerned with the projection of the total individual into the future. This concept envisages not only the recognition of the goal to be sought, and the charts of the means to attain the goal, but also the final critique as to how nearly the real has approached the ideal. This concept makes frontal lobe function definitely an intellectual one, but of a higher order than the mere solving of problems and the recollection of previous knowledge. Penfield (*9*) speaks of the frontal lobes as being concerned with "planned initiative" and Tilney and Riley (*11*) use the words "instigator of progress." We like to group many of these functions under the term *foresight*. However, there is a certain dichotomy here: foresight is retained in large measure for the objective, but often reduced for the subjective. While the operated patient may be able to function at a high level of efficiency in the matters of business, art, law, mechanics and the like, nevertheless, there is a certain disturbance in the relationship of the individual with himself that permits certain characteristics to appear, characteristics which may or may not be offensive to others, but about which the individual is either unaware or unconcerned. While he may have a good grasp of cause-and-effect relationships in regard to impersonal or outside events and can foretell the results of a proposed procedure where inanimate objects or other people are concerned, still he is either obtuse or indifferent to the effect that he himself is about to produce on other people. He is greatly lacking in what is termed self-consciousness. The following is a case in point:

CASE 1.

A school teacher and tool designer suffered from such a severe obsessive-compulsive state for a period of 30 or 40 years, that he was reduced, before operation, to performing simple jobs around the house and running errands for his wife. A year following operation, he came before the Harvey Cushing Society in Memphis and exhibited a drawing of a machine that he had recently patented, a wheel dressing device for elliptical bearings. The machine eliminated one step in the manufacture of

certain bearings and had distinct possibilities in the automotive field. He had been working with the idea for several years, he said, but had been unable to overcome certain difficulties until some months following operation when the key came to him; he sat down at his drafting board and worked out the machine in all its details. He thus demonstrated excellent capacity for visualization, for seeing in his mind's eye a complicated object and reducing it to a working drawing. It is doubtful whether anybody in the audience understood just what the machine was supposed to accomplish or could erect in his own consciousness a picture of what the machine would look like.

When this patient had finished expounding his device, he turned to the subject of a health system for rational living and proceeded to talk at length to this audience of neurosurgeons upon the dietary and spiritual assistance that had enabled him to perfect his machine. In spite of the laughter provoked in his audience by his witty sallies, he was unable to appreciate the ridiculous position in which he had placed himself and later boasted of the attention he had received.

This case, which is only the most striking of many, serves to focus attention upon the problem of the frontal lobes and the relationship of the self with the self. It is only one aspect, but nevertheless an important one. Before proceeding to discuss in fuller detail the nature of this problem, it is well to describe briefly the operation of prefrontal lobotomy and also to point out what tracts in the nervous system are probably severed.

## The Operation

The operation of prefrontal lobotomy as now carried out consists of the placing of burr holes over the coronal suture on either side of the skull in the temporal region and carrying out a subtotal, subcortical amputation of the frontal lobes in the plane of the coronal suture. The operation can be performed under local anesthesia in cooperative patients; it leaves practically no scar, and it is seldom accompanied by any troublesome bleeding. The most disagreeable sensation seems to be the drilling, and in the apprehensive patient, this occasionally becomes unbearable. After the opening is made and the dura incised, "soundings" are taken to determine the location of the falx and the orbital plate of the skull. An incision as deep as the midline may lacerate the anterior cerebral artery, while if the instrument drops down behind the sphenoidal ridge, it may injure a number of small penetrating vessels from which serious hemorrhage may arise. If the ventricle happens to be tapped, the incision is made slightly anterior to it. The incision of the frontal lobes is made on both sides in the plane of the coronal suture. A contrast medium is introduced into the incision and roentgenograms are taken for purposes of precise localization.

From the anatomic point of view, this procedure produces damage to the cortex only where the instrument penetrates and where it cuts partly through the cortex at the base of the frontal lobe. The subcortical transection of the frontal pole cuts through large areas of white matter, for the most part, we believe, association fibers connecting the frontal lobes with other areas of the cortex, including a certain number of callosal fibers. There are two projection fiber systems, however, that enter definitely into the picture, although the relationship of these systems to the operative result is not yet altogether clear. The first of these is the fasciculus cinguli which has been suggested by Papez (*8*) as a direct pathway between the hypothalamus and the cortex. The other is the anterior thalamic radiation, forming a two-way connection between the frontal pole and the nucleus medialis dorsalis of the thala-

mus. Recent experiences seem to indicate that when the fasciculus cinguli is spared there is much less dullness and disorientation and fewer sphincter disturbances than when this fibre bundle is cut. We believe that the anterior thalamic radiation is the all-important structure concerned in the personality changes brought about by operation. This bundle makes up a large portion of the anterior limb of the internal capsule. Starting as a compact fasciculus in the dorsomedial area of the thalamus, it fans out brush-wise and can be traced by defibrillation [Hultkrantz (*6*)] toward the frontal pole. We believe that this bundle linking the thalamus and the frontal lobe mediates the affective component of ideational activities.

## Postoperative Behavior

The postoperative course is usually very even and the patient is often discharged before the tenth day. During this period, there is gradual resumption of alertness and interest in outside things; previously apprehensive patients are entirely at their ease although they may persist in their mannerisms, such as rubbing their hands or even brushing "bugs" off the counterpane. Such mannerisms, we believe, represent motor patterns of behavior, the neural basis of which is rather firmly established and relatively untouched by the operative procedure. Sometimes it is only after a period of months that these useless activities subside and then apparently because they no longer serve a purpose in helping the patient to a perpetually sought security.

Fixed ideas may also persist unchanged for some time after operation. However, the affective toning of these ideas is definitely altered. The ideas are there but they are emotionally bleached as in the following case:

CASE 2.

A paranoid woman complained that acid was being sprayed on her neck, that gases were being pumped into her room, and that airplanes were dropping poison on her as they passed over her home, that she was being spied upon and persecuted by the G-men and so on. For several weeks after prefrontal lobotomy, she persisted in describing these persecutions. However, her attitude toward them was one of amusement rather than fear, and she could tell about these experiences with a smile. After the disappearance of the obsessive quality of the ideas, she was still able to recollect them and was able to describe rather graphically how they had arisen in the first place: "I was all tired out, I guess, and something happened to me that gave me a little start. I wondered what it meant and didn't quite know how to explain it, and I kept on thinking about it and trying to hitch it up with little events that had passed almost unnoticed, and I began to see a general meaning behind it all; and then one thing led to another and I got more and more frightened all the time and couldn't relax. I really felt they were after me."

This sequence of events, postoperatively, namely: first, the bleaching of the emotional component; then the gradual disappearance of the ideas followed by relinquishment of the motor patterns, has been observed too frequently to be neglected. It should be emphasized that in practically all instances the fears are in relation to the safety of the patient. They imply a consciousness of the self that has become exaggerated to an abnormal extent.

This same mechanism of pathologic egocentricity is seen with slightly different signature in many cases of involutional depression, where feelings of guilt and nihilistic delusions occupy the center of the stage and where the patient is unable to escape from a torturing feeling of inadequacy and failure. In these cases also, the image of the self looms so large in the patient's con-

sciousness that nothing on the outside is able to overcome the preoccupation. Preoccupation of the self with the self is outstanding also in cases of hypochondriasis and many anxiety states and in conversion hysteria, except that here the consciousness of the self is somaticized in that the self is now considered as a collection of organs that in the patient's mind are functioning badly.

CASE 3.

One of the most striking examples of hypochondriasis occurred in a 59-year-old cashier who complained bitterly, constantly, and clamourously about her hemorrhoids, begging for morphine to dull the pain and for an ice bag to be placed against the anus to control the horrible sensations. Actually, there were only a few atrophic skin tabs, but the general condition of the patient was so poor that carcinoma of the colon was suspected until it was ruled out by a gastrointestinal series. After prefrontal lobotomy, the patient complained no more of her hemorrhoids and upon being asked about them and her previous complaints, she stated that they had been with her for years, but that when she became depressed, they seemed to annoy her and to trouble her more and more until she was actually afraid that a cancer might be developing. Before operation, the patient was disoriented and delusional, and had been unable to work for four months, but she returned to her work at the end of six weeks and has been steadily employed for four years, making a rather satisfactory adjustment, and having few physical complaints except tiredness and insomnia.

Examples of similar behavior could be multiplied but to no particular end. We believe it is worth while to cite briefly another expression of the unpleasant consciousness of the self that disappeared following prefrontal lobotomy. In this case, the mechanisms underlying the obsessive ruminative tension state were more clearly apparent than in most individuals.

CASE 4.

Abbie M., 32-year-old telephone operator, had suffered for 12 years from a belief that she had syphilis. Positive reassurances and negative Wassermanns had no effect. She was desperate and indeed was preoccupied with the idea of committing suicide. Prefrontal lobotomy was carried out in December, 1936, by the Egas Moniz technique, with resulting improvement, so that she was able to return to her work as a telephone operator in about six weeks.

Later investigation of this case gave us an indication of why the phobia developed. Abbie was a big, strapping, mountain girl, six feet tall and weighing 250 pounds, quite shy and self-conscious in comparison with her more attractive sisters. Twelve years before operation, she had been carried off her feet by one of her sister's beaux and had indulged in some passionate love-making. With a mixture of pleasure in the experience, remorse and guilt in the matter of sisterly beau-ownership, and love and hatred of her sister who was more attractive than she, Abbie was in a decidedly overwrought condition when, a few days later, she developed a rash over the sternum where the telephone instrument rested. The rash lasted only three days, but the word syphilis flashed through Abbie's mind and remained with her constantly. Abbie's knowledge of syphilis was quite rudimentary, but what syphilis meant to her in terms of punishment for her deed, social ostracism, the relinquishment of marriage and maternity, and so on, may well be imagined. The obsession remained with her through twelve years. It was partially relieved by the operation and she went back to her work but continued writing distressed letters emphasizing her unhappiness: "I guess I just wasn't made to be happy. About two years after operation, she resigned her position in order to marry a man who was well-suited to her both physically and intellectually, but again she broke down and all the old fears came back and a number of new ones; and she returned, begging for further relief. A more extensive prefrontal lobotomy was performed in March, 1939, and since then, the patient has grown even fatter, is cheerful,

indolent, and entirely relieved of her obsession with syphilis. She has returned to her work after a rather long convalescent period and still keeps company but has no definite plans regarding marriage.

The alteration in personality brought about by prefrontal lobotomy is sometimes quite striking. A timid, restrained hypochondriacal woman now joins in the party with her daughter, is able to dance until after midnight with her daughter's friends, cook supper for them, and send them home in the midst of jests and wise cracks. She is no longer conscious of the fatigue nor is she very much aware that there is such a thing as dignity in the presence of young people. She boasts that the boys come to the house on account of her. A former school teacher, having suffered from involutional depression for six years, sits unconcernedly among a group of physicians while we are describing to them her suicidal attempts, chronic alcoholism, her erratic behavior, and harebrained plans for an artists' colony, her alcoholic father, and her psychotic mother and sister, and then smilingly states to the doctors: "I have to drink alone because I get perfectly nasty in public." For the first time in six years, however, this patient says that she is able to work without the feeling of a "crown of thorns" and a red hot spike in the back of her head. At present she is employed for $17 a week but she puts up an excellent appearance and is actually gaining weight.

This lack of consciousness of the self that results from prefrontal lobotomy may be carried too far or it may be induced in the wrong type of individual.

CASE 5.

One of our most unsatisfactory results occurred in a 58-year-old business man, who for 25 years had suffered periods of depression with anxiety and suicidal ideas. Following operation, he was for awhile indolent and cheerful but later his behavior became extremely disagreeable. He abused his wife, ordered his children out of the house, sent his secretary home in tears and tried 25 others without finding one who would stand for his tantrums, and eventually wound up in a number of law suits, some for physical violence, with his business ruined and his family alienated. Yet, as his son describes him, he walks briskly about the house and about his home town, munching candy and saying he never felt better in his life, advising everybody he meets to have the operation. A more thorough investigation into the previous character of this individual would have probably caused us to refuse operation no matter how great the clamor. This individual had always been aggressive; as a boy, he had kicked his brother's dog to death; when his father's estate was placed in the hands of a brother, he brought suit and did everything he could to humiliate the family; he took long drives by himself in an effort to relieve the inner tension and sometimes when the trouble became too great, he would shirk his responsibilities and go off on vacation or to a sanitarium. In this case as well as in one or two others, we believe that the suffering of the patient was occasioned by the conflict between the aggressive instincts and the need for their control, and that the operation served to release that control. Following operation, the patient could carry out the natural aggressions of his nature without thought of consequences. It has been disastrous for the family in this one case; as far as the patient himself is concerned, the operation cannot but be considered an overwhelming success.

The effect of prefrontal lobotomy upon the consciousness of the self may explain many of the peculiarities and discrepancies in conduct that have been noted by various individuals who have studied the frontal lobe syndrome. Some authors record marked distractibility, while others emphasize the lack of distractibility. The German authors were particularly impressed by the fatigability of patients with frontal injuries, while other investigators have noted

an extraordinary lack of fatigability and endless capacity for work. We have observed both of these contrasts in different individuals following prefrontal lobotomy and are inclined to explain them on the fundamental basis of diminution in consciousness of the self, with recrudescence in purer form of the innate energies of the individual.

The naturally energetic person proceeds with his task, unaware of feelings of fatigue that would cause the normal individual to stop. The normally indolent individual is, on the other hand, no longer concerned about the necessity of going forward to achieve his goal and therefore relinquishes it altogether or postpones the task until he feels like working. Procrastination is a very common phenomenon even in otherwise energetic people. As one lady said, "I wake up in the morning and I think of all the things I have to do, and then I say to myself, 'Oh, I'll do that tomorrow,' and then, somehow, tomorrow never comes."

Consciousness of the self stands near the top in the hierarchy of attributes of the total personality. In the cases cited briefly and in many others, it is one of those forces that underlies accomplishment and adjustment in any society. Without consciousness of the self the human race could not have risen as far as it has in the scale of living beings. On the other hand, we believe there can be too much of a good thing, and if consciousness of the self, either as an aggregation of organs or as a unit of society, becomes in any way fixed or obsessive, the more useful activities of the personality may be correspondingly diminished. In extreme cases, a disabling psychosis or neurosis may result. We believe this factor in the personality is mediated by the frontal lobe since the more complete the removal of the frontal tissue, the more striking the lack of this function; whereas gross lesions produced in other parts of the brain do not seem to interfere with the function in anything like the same degree. To some extent, this function presents an intellectual facet, namely, foresight, the projection of the individual into the future and the recognition of the image of the self in the act of becoming. There is also the affective facet, the emotional charge connected with that image. The operation of prefrontal lobotomy seems to be specific in reducing the affective component of the image of the self as constructed by the frontal lobes. Only immediately following the operation in the stage of diaschisis is the lack of foresight absolute or even relatively great, whereas later on the patient is able to foretell with considerable probability what will occur in case a certain activity is carried out. Yet he is notably unconcerned about possible repercussions upon the self and especially about the possibility of failure.

In cases in which individuals are suffering from a sickness that is associated with too distressing ideas in regard to the future, a consciousness of the self that envisages contamination, guilt, persecution, incurable disease, and the like, and in which the ideas have become so fixed that they menace the integrity of the personality and threaten disability or suicide, it seems justifiable to use any safe method in diminishing that affective component. Prefrontal lobotomy finds its most successful application in cases in which the consciousness of the self is obsessive and accompanied by an intense emotional feeling tone. The most satisfactory results (see Tables 1 and 2) have been obtained in cases of involutional depression, particularly with agitation, and in the various obsessive states whether decorated by compulsions, ruminations, or hypochondriases. The energy component of the personality is apt to have a rather large part in the

TABLE 1
SOCIAL ADJUSTMENT OF PATIENTS

| Diagnosis | Number | Regularly Employed | Studying or Partially Employed | Housekeeping | Home | Institution | Operative Death | Died Subsequently | Recent Cases |
|---|---|---|---|---|---|---|---|---|---|
| Involutional Depression | 29 | 4 | 1 | 15 | 4 | 1 | 1 | 1 | 2 |
| Obsessive States | 17 | 5 | 1 | 6 | 3 | — | 2 | — | — |
| Schizophrenia | 11 | 4 | — | — | 5 | 1 | — | 1 | — |
| Chronic Alcoholism | 2 | 1 | — | — | — | 1 | — | — | — |
| Anxiety Neuroses | 2 | — | 1 | 1 | — | — | — | — | — |
| Hysteria | 1 | 1 | — | — | — | — | — | — | — |
| Undifferentiated | 4 | 1 | — | 1 | 1 | 1 | — | — | — |
| Total | 66 | 16 | 3 | 23 | 13 | 4 | 3 | 2 | 2 |

TABLE 2
RESULTS OF PREFRONTAL LOBOTOMY

| Diagnosis | Total | Good | Fair | Poor | Operative Death | Died Subsequently | Recent Cases |
|---|---|---|---|---|---|---|---|
| Involutional Depression | 29 | 17 | 7 | 2 | 1 | 1 | 2 |
| Obsessive States | 17 | 12 | 1 | 2 | 2 | — | — |
| Schizophrenias | 11 | 5 | 4 | 2 | — | 1 | — |
| Chronic Alcoholism | 2 | 1 | — | 1 | — | — | — |
| Anxiety Neuroses | 2 | 1 | 1 | — | — | — | — |
| Hysteria | 1 | 1 | — | — | — | — | — |
| Undifferentiated | 4 | — | 1 | 3 | — | — | — |
| Total | 66 | 37 | 14 | 10 | 3 | 2 | 2 |

subsequent adjustment of the patient for the reasons given above, namely: that the naturally industrious goes forth unhampered by feelings of fatigue while the naturally indolent subsides into a *dolce far niente*, (Bianchi, *1*). The more aggressive patient, such as we find not infrequently in the obsessive-compulsive group, may cause some embarrassment by rather unrestrained behavior. On the other hand, if aggressive behavior is part of the psychosis and is determined and inaugurated by anxiety and fear for security for the self, prefrontal lobotomy is practically specific.

Prefrontal lobotomy is no panacea and is not to be used indiscriminately. The operation should be performed only in those cases presenting a poor prognosis, not necessarily measured in terms of chronicity, but rather in terms of rigidity of personality and possibility of restoration to useful activity in spite of some tactlessness and lofty intransigeance.

## SUMMARY

Prefrontal lobotomy bleaches the affective component connected with the consciousness of the self. Patients who are afflicted with a distressing consciousness of the self (either as a unit of society or as a collection of organs) and whose preoccupation is fixed and unyielding, will secure from prefrontal lobotomy definite relief even though certain of their ideas and actions may persist for a long time. Reduction of the affective component allows the personality to appear in purer form, divested of certain restraining features, but essentially unchanged in regard to energy and intelligence, the principal change being an alteration in the direc-

tion of interests from within, outward. Prefrontal lobotomy is radical treatment, not only figuratively but literally in that it reaches down to the roots of the personality. If the neurosis or psychosis has its roots in an overwhelming consciousness of the self, and if this consciousness is intractable and disabling, then prefrontal lobotomy may bring peace to the warring mind and a new lease on life.

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# MYASTHENIA GRAVIS AND PSYCHOSIS. REPORT OF A CASE WITH OBSERVATIONS ON ITS PSYCHOSOMATIC IMPLICATIONS*

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ALTHOUGH MANY OBSERVERS have made incidental mention of mental disorders associated with myasthenia gravis, Collins (*6*) alone, in 1938 made this the basis of an individual report. He cited two cases, one in which three periods of depression preceded the development of the myasthenic syndrome, and another which was characterized by hyperkinesis, elation, aggressiveness, disorientation and delusions of poisoning and destruction. Earlier, in 1905, Buzzard (*4*) mentioned a case with depression, suicidal tendencies, and delusions of persecution, and he reached the conclusion that myasthenia gravis had a specific pathological anatomy, due possibly to some toxic or autotoxic factor, and that psychic symptoms were an integral part of the disease picture. Markeloff (*15*) in citing a case of dementia praecox, and one in which apathy occurred as a prominent symptom, reached a similar conclusion although on a different premise, and included mental disturbances in the symptomatology of myasthenia gravis. Other authors, however, such as Hun (*11*) and Oppenheim (*17*), stated specificially that mental abnormalities played no part in the disease. Keschner and Strauss (*13*), in citing a case of myasthenia gravis associated with a depression which lifted coincident with the general improvement following therapy, considered such reactions within the range of normal and a comprehensible development in a person afflicted with a disease of such disabling character. Boothby (*3*) mentioned two cases, one with depression which terminated in suicide and one which exhibited mild hysteria. Included in the series reported by Kennedy and Moersch (*12*) were seven cases in which depression occurred, one of which resulted in suicide. The psychic reactions in myasthenia gravis, according to their conception, were not specific but the tendency to emotional disturbance usually took the form of anxiety or depression. They stated furthermore that the symptoms of chronic fatigue and the expressionless facies so prominent in myasthenia gravis were often misinterpreted as neurasthenia, hysteria, or other psychoneurotic reactions.

Although certain anatomical lesions have been reported in the central and autonomic nervous systems and other organ systems, with the exception of lymphorrhages in the muscles and thymus hyperplasia, these have been slight and inconstant, and give little basis for a pathological-anatomical substratum to the symptomatology of myasthenia gravis either in the somatic or psychic aspects. Keschner and Strauss summarized the disease picture as follows: " . . . the only rational conclusion that the clinician can draw is that myasthenia gravis is a disease characterized by a

* The material which forms the basis of this paper was obtained on the Admission Service of the Springfield State Hospital, Sykesville, Md.

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functional disturbance in the nature of a peculiar muscular fatigue induced by some unknown endogenous poison or poisons with a peculiar selective affinity for the muscles and their motor and sympathetic (?) nerve endings, as well as for the sympathetic component of the hemopoietic system, and for the endocrine system, especially the thymus."

In the past few years with the discovery of the remarkable effect of prostigmine on the muscular symptoms of myasthenia gravis, a considerable amount of research has been done on the effects of adrenergic and cholinergic drugs and their rôle as the chemical mediators of the nerve impulse. In myasthenia gravis there may be an underactivity of the cholinergic mechanism at the motor nerve terminals with a diminution in the amount of cholinergic substance requisite for the normal muscular stimulation. This, however, is probably the last link in a chain of events of which the intermediary changes are little known. The present conception of myasthenia gravis resulting from such clinical and biochemical studies is that of a disease involving the myoneural junction conditioned by general bodily disease, possibly in the nature of an imbalance of the autonomic nervous system with associated endocrinal dysfunction. The fundamental etiology, however, is not yet determined and it is uncertain which of the effects observed are primary and which are secondary. Certainly, however, it is a disease of the whole organism and is not restricted to any one specific organ or organ system.

In consideration of a mental disorder occurring in perhaps a predominantly somatically conditioned disease such as myasthenia gravis, several questions require consideration as to the origin of such disorder and its relation to the somatic illness. 1) Is the somatic disease determined by predominantly psychic factors and the result of long continued psychophysiologic and finally irreversible pathophysiologic changes? 2) Is the mental disorder one manifestation of a general toxic or metabolic disease? 3) Is the mental disorder a reaction to a chronic disabling illness and, therefore, a result of a specific situational determining factor? 4) Is the mental disorder a reflection of constitutional, hereditary and environmental factors related only incidentally to the somatic disease with its own more or less independent onset, course and termination? In the present state of our knowledge of the chemistry and metabolism of muscle, the relation of the latter to the vegetative-endocrine system, and in turn the relation of both these factors to emotional and psychic influences, these questions must remain to a large extent problematical. It is probable, however, that they are by no means mutually exclusive and that all contribute to the total picture of the disease.

The following case is presented not only because of the infrequency of psychotic reactions in myasthenia gravis but also because it is illustrative of many of the problems of psychophysical interaction.

## Case Report

Patient D. L., age 38, admitted to the Springfield State Hospital, January 19, 1940, with complaints of weakness in the lower extremities, diplopia and attacks of dyspnea since October, 1937. Two years later, while in a hospital, he became depressed and developed delusions of persecution and grandeur.

*Past History:* Delivery was spontaneous and birth uncomplicated. He had a large head but this was said to be a family characteristic and present both in his father and a brother. Early development was normal with the for-

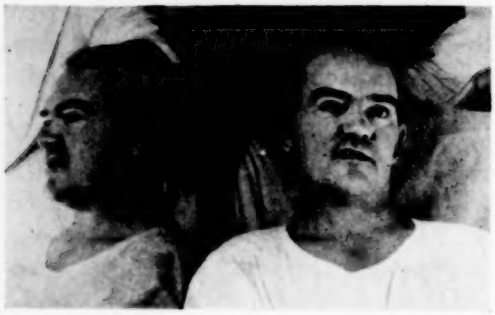

FIG. 1. Patient is attempting to smile. Note facial paralysis on left and weakness on right.

mation of appropriate eliminatory habit patterns at the usual age. As a child he was unusually quiet and in spite of episodic temper outbursts was considered well-behaved and obedient. The father was austere and detached and the management of the large family devolved upon an indulgent but inadequate mother. There was, accordingly, a great deal of sibling rivalry with especially keen competition for the mother's attention and affection. The patient fared poorly in this competition and felt the resultant deprivation intensely. He began school at the age of six and completed the sixth grade at the age of 15. His school record was poor and he repeated two grades which was believed due partially to lack of interest and partially to inadequate comprehension. When he was sixteen years of age he suffered from typhoid fever to which both of his parents succumbed. The subsequent break-up of the home left the patient without his sole affective attachments and for the next several years he led an aimless existence, exhibiting little capacity for substitutive relationships. Shortly after this while working in an arsenal, a blast occurred in which many men were killed and the patient became tense, apprehensive, and subject to paroxysms of weeping. Coincident with these events, the patient suffered a moderate depression which persisted intermittently for five years. At the age of 18 he had a bilateral herniorrhaphy with a subsequent left testicular atrophy. Two years later he was struck on the left side of the face by a baseball bat and was unconscious for several hours. A sequel of this injury was a left facial paralysis of peripheral type which made a gradual but only partial improvement.

After leaving school he had a succession of temporary laboring jobs until 1925, when at the age of 24 he obtained a position as truck driver which he held up to the present illness. He evinced no interest in women until the age of 20 when he became acquainted with a Catholic girl. Although his suit here was unsuccessful, he changed his religion from Protestant to Catholic and has been a devout Catholic since that time. He married the second girl of his acquaintance at the age of 21 and marital adjustment was reported as essentially satisfactory. The patient made a close identification of his wife with his deceased mother, frequently commenting on their similarity and reiterating that his wife had been sent by his mother to take the latter's place. Since the birth of the only child three years after marriage, the patient regularly practiced coitus interruptus. He did not desire further children because of the difficulties he himself had had as a child and this was the only method of contraception open to him. His wife was the dominant partner and took full management of the home and the family finances. Under this maternal and protective influence the patient made a satisfactory adjustment on a limited social and occupational level until the advent of the present illness.

*Personality:* The patient had always been a reticent individual with a quiet, retiring disposition; an extremely hard worker and a devoted husband and father. He used neither alcohol nor tobacco and was a frugal person with the

single ambition to save sufficient money to purchase a small farm. He had few social contacts and no interests outside of the home with the exception of religion. He became a devout convert to the Catholic faith and was greatly affected by the rituals and mysticism. On one occasion when his truck was stalled he prayed fervently to God, following which he was immediately able to continue. Another time while unloading some coal something told him not to do so and he therefore adamantly refused. In his interfamily relationships he was unusually passive but at times showed periods of unaccountable obstinacy.

*Family History:* His father was a rigid authoritarian, detached and alcoholic, but always provided fairly well for the family. His mother had a kindly sympathetic disposition but was unable to adequately control or manage the children. The patient was the second child in a family of six, two of whom were unstable and subject to fits of hysterical weeping. There is no history of any nervous or mental diseases in the direct or collateral family tree.

*Present Illness:* On October 8, 1937, the patient fell 18 feet from a trestle striking the base of his spine and his head. He was unconscious for a few minutes but after recovering was able to return to work. Two weeks following this accident he complained of weakness in the lower extremities and on several occasions fell, sustaining minor injuries. At the same time he developed diplopia. In the course of the next five weeks other muscles became progressively involved until the patient had difficulty in swallowing, in closing his jaws during mastication, and required both hands in shaving. He finally became so weak he had difficulty in raising his arms or in sitting up. Concurrently impotence developed. He was admitted to a hospital on November 21, 1937, for study. On December 12, 1937, while in this hospital a tooth was extracted. Following this he was unable to expectorate mucus and blood and developed an intermittent temperature which at times reached 104° F. Extreme dyspnea and cyanosis resulted with a rise in the pulse rate to 130, in the respiratory rate to 36, and an almost complete diaphragmatic paralysis. A diagnosis of myasthenia gravis was made and with the administration of oxygen and prostigmine and the lancing of a peritonsillar abscess the patient improved. He was placed at first on parenteral prostigmine and then on oral prostigmine, 30 mg. every four hours and subsequent attempts to reduce it were impossible. On December 13, 1937, the patient was described as cheerful, intelligent, and cooperative but by January 19, 1938, he became frequently discouraged and occasionally suggested suicide. He was discharged from this hospital January 24, 1938, with a maintenance dose of 150 mg. of oral prostigmine daily. There was apparently little change, however; he was unable to lift his head or feed himself, had many choking spells and his speech frequently became paralyzed. The prostigmine was discontinued in May, 1938, following which his wife insisted he improved, was able to chew and swallow and to sit up and read the paper. There was possibly some progression of the symptoms after one year but no attacks of dyspnea or cyanosis. During this period the patient remained at home, fairly well adjusted to his illness. On July 7, 1939, he contracted an upper respiratory infection with profuse viscid mucus which he was unable to expectorate. Dyspnea and cyanosis resulted and he was rushed to a hospital where he revived in an oxygen tent after the administration of prostigmine. On this occasion he was in a semicomatose state with a pulse rate of 80 and a

respiratory rate of 10. Examination at this time was not essentially different from the former hospital admission. He was placed on prostigmine, oral and parenteral, and guanidine in amounts ranging from gms. 1 to gms. 1.7 every 8 hours but with the higher doses untoward reactions occurred. In addition, he received potassium citrate gms. 2, three times daily. In October, 1939, while still in this hospital, he became depressed and had periods when he would stare in a preoccupied manner. He would become violently angry and accuse his wife of running around with other men, but such an outburst would be followed by an immediate apology. On one occasion he impulsively attempted to choke his wife. Frequent periods of weeping occurred and he insisted his wife was in league with his persecutors. He was transferred to a mental hospital December 14, 1939, where he had periods of euphoria alternating with periods of irritability. Delusions and hallucinations were a prominent feature and he established the validity of the resultant beliefs by numerous biblical quotations. He was transferred to the Springfield State Hospital January 19, 1940.

### Physical Examination

The patient was a short, well-nourished individual of pyknic habitus, 5 ft. 4 in. in height and 145 lbs. in weight. He was poorly cooperative because of his delusional ideas and denial of illness as well as his inability to perform many of the tests requested.

*Neurological Examination:* The patient's head was large and appeared hydrocephalic, measuring 62.2 cm. in circumference. The gait was shuffling and uncertain and he was unable to take more than two or three halting steps. The equilibratory coordination tests were reasonably well performed considering the muscular weakness. The nonequilibratory coordination tests were done with fair accuracy at first but on repetition, as a result of rapid fatigue, marked disturbances with no consistent laterality were apparent. Speech was normal except in prolonged conversations during which the patient would pause frequently for recuperation. There were no abnormal involuntary movements except for a fine tremor of the fingers of both hands and of the tongue. The deep reflexes of the extremities were equal and active, the superficial cutaneous reflexes were hypoactive but equal and there were no pathological reflexes. Sensation showed no disturbance in any modality.

Muscle strength was fairly effectual after intervals of inactivity and the patient in a combative period was able to strike rather heavy blows. On one occasion he severely bit an attendant. Such violent exertion, however, was followed by a period of complete passivity when he would lie with his eyes closed, immobile, the breathing slow and shallow and a slight cyanosis diffusing the face. The muscles of the thighs and pelvic girdle were particularly affected. The patient was able to raise his right leg to a distance of three feet at first with progressively smaller excursions each time for ten trials when complete exhaustion resulted. Electrical reactions of the muscles showed normal excitability to the faradic current and correct polarity with the galvanic. The right sternomastoid and extensors of the right wrist ceased to respond to faradic stimulation after 70 shocks. With galvanic stimulation there was no fatigue after 100 contractions.

The eyes, particularly the left, were prominent; the left palpebral fissure was widened and there was a slight ptosis of the right lid, especially on prolonged ocular fixation. A nonparalytic weakness of the extra ocular muscles, most marked in the left lateral rectus

was present, with crossed diplopia to right gaze and homonomous diplopia to left gaze. The patient had learned to some degree to suppress false images. Vertical movements of the eyes were normal except for slight restriction of upward gaze. Visual acuity was 20/15 O.D. and 20/20 O.S. and there were no abnormalities of the optic fundi. The pupils were equal, regular and reacted promptly to light both directly and consensually.

The muscles innervated by the 5th, 9th, 10th, 11th, and 12th nerves all showed a moderate degree of weakness and fatigability but the patient's lack of cooperation prevented adequate testing. The patient showed the residua of the left facial paralysis sustained in his youth and on the right the muscles of volitional control and emotional expression became rapidly paretic.

*Systemic Examination:* There was no lymph adenopathy and the thyroid was not palpable. No clinical enlargement was disclosed in the examination of the heart but an accentuated aortic second sound was present and a soft systolic murmur in the apical area. The blood pressure on admission was 174/122, but within two weeks had subsided to 140/80. However, during emotional

LABORATORY EXAMINATION

*Blood Chemistry*

| | 1938 | 1940 |
|---|---|---|
| Sugar | 102 | 95 mg.% |
| NPN | 32.1 | 30 " |
| Creatinine | 1.7 | 1.5 " |
| Uric Acid | — | 2.5 " |
| Chlorides | — | 470 " |
| Cholesterol | 270 | 175 " |
| Calcium | — | 10.75 " |
| Phosphorus | — | 2.85 " |
| E.S.R. | 30 | 2.5 |
| Cell Volume | 59 | 56% |
| Wassermann | Neg. | Neg. |
| $CO_2$ Comb. Power | — | 53 Vol.% |
| Total Protein | — | 6.8% |
| Albumin | — | 4.2% |
| Globulin | — | 2.6% |

*Blood Count*

| | 1938 | 1940 |
|---|---|---|
| Hemoglobin | 100% | 90% |
| RBC | 4.95 | 5.05 |
| WBC | 10,500 | 9,800 |
| Neutrophiles | 55 | 67 |
| Juveniles | 15 | 3 |
| Lymphocytes | 24 | 27 |
| Monocytes | 4 | 1 |
| Basophiles | 0 | 2 |
| Myelocytes | 2 | 0 |

*Cerebrospinal Fluid*

| | 1938 | 1940 |
|---|---|---|
| Cells | — | 2 |
| Total Protein | — | 25 mg.% |
| Wassermann | — | Neg. |
| Kahn | — | Neg. |
| Colloidal Gold | — | 1100000000 |

*Urinalysis*

| | 1938 | 1940 |
|---|---|---|
| Sp. gr. | 1015 | 1030 |
| Reaction | acid | acid |
| Albumin | 1 plus | 0 |
| WBC | 8–10 | 3–5 |
| Epith. cells | 0 | occas. |

*Special Tests*

| | 1938 | 1940 |
|---|---|---|
| Basal Metabolic Rate: | Minus 13. | Plus 1 |
| Urine Concentration and Dilution: | — — — | Specific Gravity 1004 to 1030 |
| Glucose Tolerance Test: (Blood and Urine Sugar) | 102; 173; 210; 168; 87. — — — | 100; 250; 333; 200; 111. 0; Tr.; 1+; 3+; 2+. — — — |
| Muscle biopsy: | Pigmented muscle cells. | |
| Electrocardiograph: | Rather prominent S 1 and S 2; otherwise no abnormality. | PR .16, QRS .04. Normal sinus rhythm. Normal electrocardiogram. |
| Roentgenograms: Chest: | Pulmonary congestion. | Negative. No abnormal shadow in superior mediastinum. |
| Skull: | — — — | Calvarium increased in size. Cranial fossae lengthened. Areas of slight rarefaction anterior to right frontoparietal suture and superior portion of occipital bone. Pineal gland visualized and by measurements in normal position. |

outbursts or periods of motor activity it would frequently rise to 190/120 followed by a gradual fall. The pulse was full with fairly high tension but was occasionally irregular due to premature contractions. The rate varied from 80 to 140 depending on the patient's prevailing psychic or somatic status. There was no evidence of peripheral or central arteriosclerosis. Examination of the lungs revealed faint vesicular breath sounds. Costal breathing was limited and respirations were mainly abdominal in type. The rate varied from 12 to 30 and occasional hiccough occurred. Other systems manifested no abnormalities.

### Mental Examination

*Rapport & Affect:* For several weeks following admission the patient had sufficient strength to make several circuits of the ward in a wheel chair but at a later date complete confinement to bed was essential. For the most part, when not otherwise engaged, he lay quietly, apparently preoccupied, with body immobile and facies expressionless, only on occasion assuming hallucinatory attitudes. The principal difficulty in the investigation of this case was the formation of an appropriate rapport. The extreme degree of suspiciousness and the tendency to misinterpret and incorporate in his delusional system random occurrences on the ward, movements of the examiner's hands and even the routine procedures such as bathing and meals, resulted in a persistent rejection of medication or psychotherapy. Furthermore, as will be shown later, extreme caution, even in casual conversation, was necessary because of the patient's delicate balance in the somatic sphere, especially the respiratory-affective mechanism. Biochemical and psychological tests had to be applied at odd moments when the opportunity presented itself and as the fluctuations in rapport permitted. The affective tone was limited in range; most prominent was the irritability stemming partially from the enforced inactivity and partially from the constant attention to the unpleasant hallucinatory and delusional projections. At rare intervals the patient laughed, always in response to hallucinatory remarks, a reaction which at times he himself sensed as incongruous with the prevailing situation. Invariably when asked how he felt, the patient would reply, "wonderful" in a spiritless low tone. Fleeting mention of loneliness and depression was made but rapidly dissimulated with grandiose remarks. For periods, under the influence of ideas of omnipotence and rebirth, he would become somewhat euphoric, but this emotional reaction was never sustained and a reversion occurred to irritability and outbursts of anger. The latter constituted one of the major problems. On numerous occasions, sometimes two or three times a day, under the influence of vivid persecutory ideas and torturing hallucinatory voices, frustration, resentment and rage would dominate the patient. At such times the respiratory excursions would gradually diminish and a slow cyanosis ensue. Following removal of all provocative stimuli, a gradual recovery would occur.

*Grasp:* Orientation was variable. On admission he was correctly oriented in all three spheres but within two weeks temporal orientation showed partial defect. He was able to repeat five digits forward and four reversed; simple calculation was adequate; general information was commensurate with educational status and the formal judgment problems were adequately done. He was able, however, to perceive only two of the five Binet absurdities. His response to serial 7's was as follows: "*93*, 84, *73*, 64, *53*, 44, *33*, 24, 18." In a previous study (*10*) it was found that this per-

severating (B type) of response is indicative of diffuse mental disorganization of either an organic-structural or functional nature.

*Stream of Talk:* The patient as a rule was coherent and relevant and able to carry on a protracted conversation fairly well, although he had to pause at frequent intervals to regain strength in the muscles of articulation. Only when excited would he sometimes become incoherent with associations which were extremely difficult to follow. His conversation was usually quite animated and he would use gestures to illustrate remarks as far as his strength permitted. When any topic was broached the patient had a tendency to discuss generalities at first but persistently returned to himself and his delusional topics. Occasionally marked circumstantiality was evident with a constant exposition of his delusional beliefs and a persistent disregard of interruptions. The patient was argumentative and self-assertive and even an indirect suggestion of disagreement with his concepts would arouse irritation, acusations of ignorance and presentation of much data to bolster his contentions.

*Content:* The major portion of the patient's productions were concerned with his delusional ideas and these have been loosely arranged in a series of prevailing attitudes.

*1. Marital Attitude:* Previous to the onset of his illness, marital adjustment was said to have been completely satisfactory and there were no overt expressions of hostility towards his wife. He made a close identification of his wife with his mother and indeed the personalities of the two were extremely similar. His wife was the dominant person of the two and managed the family finances and the upbringing of the child. In the earlier part of his stay in the hospital his wife figured largely in his delusional formations and hallucinatory experiences and marked ambivalence was apparent in his reaction towards her. He carried on constant imaginary conversations with her and would frequently interrupt discussions to listen to her or to speak to her. He often expressed surprise that the examiner was unable to do so and urged him to attempt it. Uncertainty of his own rationality and his ambivalent attitude to his wife are indicated in the following productions. "They think I am talking to myself. Sure I love you; I am trying to get you mad so you will take me out of here. I am sorry I called your mother those names. You say they are trying to commit me to the Maryland Penitentiary? I do not understand you at all; I have been good to you." He then turns to the examiner and says: "My wife is always kidding me; she kids me she will take me home in a box. She can read my mind and can hear what you are saying through me or through my mind. She stays here day and night talking to me. They talk to me in a microphone at the office too. This building is rigged up that way under the floors. You can talk with your mind and that way it goes through the building; you don't actually have to talk, it's a wonderful system; you can do it without moving an eyelash. It's hard to talk." On one occasion he heard "divorce, divorce, divorce" continually repeated and his belief that his wife was associated with this was the basis of his attack upon her. In discussing the electricity which pervaded his body he said it was "my wife did that just to tease me; it wasn't a shock, just a little tingle. It works by a button." Later on the patient became terrifically angry and cursed his wife for tormenting him with the electricity which was produced by an "infernal machine." His wife had other tortures for him. She would tell him to get up and walk and would laugh when he fell down in the

attempt. However, he became very indignant when he heard the voices of the attendants insulting his wife by calling her a pervert, a prostitute, and other vile names. Two weeks after admission his hallucinatory contacts with his wife diminished and were replaced by the encouraging and laudatory voices of his mother and the Virgin Mary.

*2. Attitude to Religion:* The patient made a close identification of his mother with the Virgin Mary and often used their names interchangeably. This use is illustrated in the following excerpts. "The Virgin Mary gave me advice, told me to keep on trying, not to give up. My mother is in Heaven, she can change the messages and send them SOS for you. I spoke to Jesus too; he told me to have courage, not to give up." He expressed many ideas of power and of omnipotence. "I have the power because I believe. I never have any pains or aches because I love the Saviour and the Blessed Virgin. I have more friends in the world than anyone —I love them—I love everybody—I forgive everyone—I am here to protect women and children. I was in Hell but I was alive—they treat me the same as a Saviour. The Virgin Mary just kissed me." He said he was here a long time ago "since the earth was laid," and was put on this earth to be a "leader." At various times the patient believed himself appointed by the Lord to "spread knowledge over the world," to see that punishment was meted out to the wicked and rewards given to the good. He was "protector of women and babies" for which he was given esoteric powers essential to his rôle. He had established, however, no specific province and on different occasions arrogated to himself spiritual, secular, governmental or hospital authority. He felt that Jesus had intervened directly in his case, had made it unnecessary for him to adhere to the eliminatory habits of ordinary people and that he was free from aches and pains through this intervention. Furthermore, God had stricken him not with a disease but with immobility in order that he might spread from his bed in the hospital the gospel of righteousness throughout the world. He speaks of his mother as if she were alive and had "never died." "I love my mother very much; I put my arms around her neck and kiss her; I give my health to her."

*3. Attitude to Examiner:* Ambivalence was the prominent feature of the patient's attitude to the examiner. Although the predominant affects were anger and hostility, at intervals a feeling of friendliness was perceptible. Furthermore, there were indirect expressions of homosexual interest. In the course of discussion the hallucinatory voice of his wife would tell him that she wished to "talk love" to the writer. She would further tell him to "keep his shirt down" because he was in a room alone with a man. Most frequently he irately accused the examiner of putting "Poison in the food," of "shooting dope into poor people" and of "beating the poor human bodies." He insisted he was brought here "to be killed" and his body was being used "for experimental purposes."

*4. Sexual Attitude:* The patient revealed many evidences of latent homosexual tendencies. He affirmed that he was half man and half woman and in this connection was concerned with the significance of opposites. "You are in the form of a man; you are half a woman too; you are half your father and half your mother together; one might be bad and one might be good; the badness might show up sometimes and the goodness might show up sometimes." His identification with the feminine is further indicated by his claim that the Virgin Mary had changed his surname

to "W," his wife's maiden name, and thenceforth he called himself "D.W." which symbolized his "half man, half womanhood." He became preoccupied with the meaning of the word "Mr." and said that for him the "r" was the difficulty and must be taken out and replaced by "Miss." The "r" appeared to be the symbolic representation of masculinity. Awareness of these homosexual components, however, did not reach the level of consciousness and the patient even pointed to his daughter as evidence of his heterosexual capacity and satisfaction. In addition to these mechanisms the patient made a further identification with his sister, age 24. He said he loved her dearly and would "move in with her and share her body with her." The hypothetical question of his sister's marriage with the resultant chaotic sexual situation he resolved by affirming the spiritual nature of his incorporation into his sister's body.

5. *Attitude to Self:* A number of the productions relating to himself were determined by previous experiential factors and others determined by the fact of illness. He had some realization that his hallucinatory projections were alien to other people and was sensitive of the allegations of insanity which had thereby resulted. This was rationalized by the assumption of special powers. He asserted he was admitted to "have his mind tested," and "all kinds of apparatus" was used on him. He deplored the inability of people to understand him and their suspicions of his sanity and insisted that he "actually caught hold of the Virgin Mary's hand." He contended that he "got in wrong because he told them the truth." The shock he experienced at the age of 16 he regarded as "collapsed nerves" and said he "just cried and couldn't stand anything." He described his attempted readjustment following the death of his parents as an effort "to take it up," but others "tore it apart." These attacks occurred he said, at 16-year intervals. He made a grandiose evaluation of himself, asserting that "babies by the thousands were murdered" when he was doped and that his body contained "little angels."

6. *Attitude to Illness:* Portions of the patient's productions were obviously compensatory or substitutive for the organic disability. His system of communication by telepathic means without demands on movement or articulation, precluded the necessity of using the musculature of the speech apparatus with its disturbing fatigability. On occasions when he had hardly sufficient strength to respond, he "was in Heaven," and ignored remarks because he was "forbidden by the Saviour to reply," although he was aware of everything that was said. Generally the patient was unable to accept his illness and many of his productions were an obvious rejection and a rationalization of the symptoms in terms of his delusional ideas. He was acquainted with the formal diagnosis of his illness but minimized the consequences. Myasthenia gravis was "nothing, just a name meaning part use of the body; a condition where the nerves were weak," and he insisted he was "better and in a short while would be perfect." Diplopia was a transitory phenomenon, Jesus having given him double vision because he was "two in one."

The patient's illness was at first ascribed to a benign and Holy influence, then attributed to the evil machinations of individuals and organized groups. He alternated or expressed simultaneously this dual etiology. The hospital authorities were doping the food, but the "power was guarding him." The Virgin Mary would "make his hand weak" and "the poisoned food" would fall. At other times his illness

was the result of Divine intervention. God made him sick to prevent his "taking the law into his own hands" and to force him "to talk things over instead of fight." Again the patient said: "My body represents the earth. When dope comes in it weakens the earth; as people are executed it strengthens it, makes the nation stronger." An indication of tremendous hostility can be noted in these statements, with the utilization of his muscular weakness as an effective factor preventing the release of hostile aggressive impulses. His forced preoccupation with disease resulted in some bizarre medical conceptions.. "White life" was a mysterious substance which prevented harm to the body. It went "through the system to the brain" and was the "fluid in the brain which one lived off of." When an individual was ill his white life "was getting darker; when dead, it was black."

At times the patient felt that divine agencies were demonstrating through him the behavior of individuals who were hanged or gassed. This was done "to learn doctors and nurses how to care for people." On other occasions his episodes of dyspnea and cyanosis formed the basis for fantasies of rebirth or resurrection. He was "reborn in an oxygen tent" and his body was "rebuilt ready to walk," but as a result of assaults on him "the white life was cut out." Again he said: "I have died but I am still alive; I have died right in this bed but I will never die; a deadless sinner is dead." In this way he sought, without admission of illness, to interpret and rationalize his frequent periods of respiratory distress.

Instances of depersonalization appeared with the progression of his symptoms. He began to speak of himself in the third person. D. L. wasn't "alive any more" and was "talking from the dead." D. L.'s body was "lying still" so he moved in "to investigate." He could furthermore project his detached psyche into anybody he selected and could simultaneously be "here and somewhere else." As reason and logicality became more remote factors in the control of mentation, the patient appeared to himself as an aggregate of opposites which he made little attempt to reconcile. He was "a poor man and a millionaire, a corpse and alive, a man and a woman." Regressive phenomena appeared in his interpretation of the injection of prostigmine as the administration of serum from a grasshopper. He had found tobacco crumbs in his bed and accepted as fact the child's conception that the grasshopper was able to spit tobacco juice. Furthermore, he considered himself "a baby, a baby reborn," and, therefore, was unable to carry his adult body. It seemed at times that he had a trace of understanding that anger had a deleterious effect on his symptoms and asked if it had ever been known that a person could be "so darned contrary that he couldn't walk." He refused, however, to take medicine and said confidently that he was leaving shortly "on a stretcher in a $10,000 limousine with his boys the firemen." Scattering became more marked and the patient made such remarks as: "I was with King George yesterday. Why did he beat the tiger on the nose? Because he is my best friend." Many evidences can be noted in the productions given above of the three types of thinking disorder shown by Cameron (5) to be characteristic of the schizophrenic reaction; namely, asyndesis, metonymy, and interpenetration.

*Course in Hospital:* As the behavior chart indicates, (Fig. 2) the patient's clinical condition became progressively worse with intensified periods of dyspnea and cyanosis. Expansion of his delusional ideas occurred, which became increasingly bizarre with few evi-

Form M-66

## SPRINGFIELD STATE HOSPITAL

WARD East I UNIT HISTORY NO. 15938

NAME D. L. PSYCHIATRIC NO.

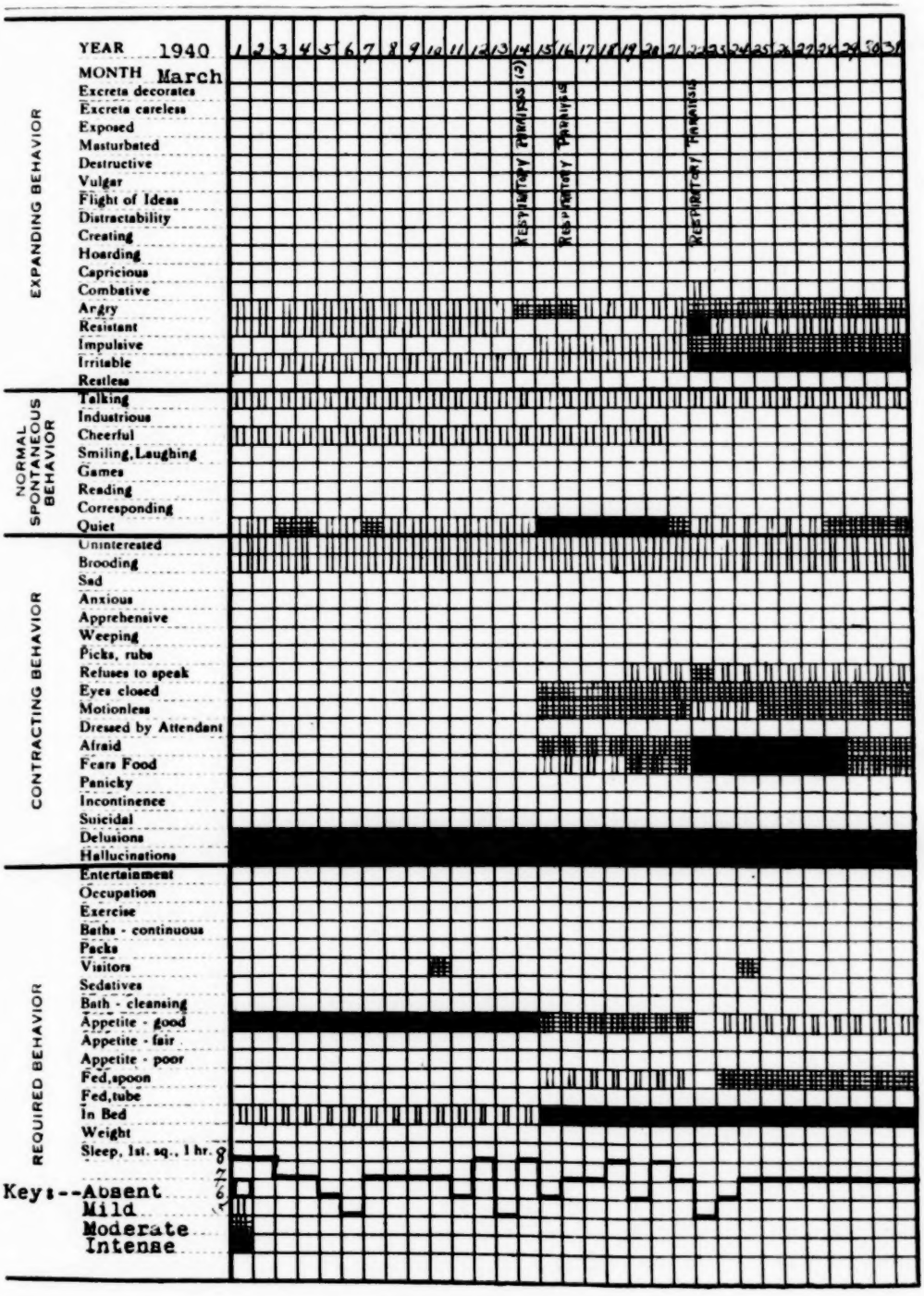


FIG. 2. Behavior chart of D. L. (Adapted from the behavior chart used in the Henry Phipps Psychiatric Clinic, Baltimore.)

dences of systematization. On April 4th, following a paroxysm of intense weeping, he developed extreme dyspnea and cyanosis; the respiratory rate rose to 30 per minute and alternated between 12 and 30. There was marked salivation and so much difficulty in expectorating mucus and saliva that an aspirator was required. Occasional twitching movements of the left (paretic) side of the face were noted and dilatation of the ala nasi on the left. He was given prostigmine, 10 mg. intramuscularly and .0004 mg. of atropine. On its administration the patient insisted it was not he who was unable to breathe but the "one he moved in with." Following his recovery the patient told a story of a woman in labor who was prevented from expectorating mucus by an oxygen mask which had been applied to her nose and mouth. Her suffering was reflected in his body and he himself had actually been in no danger of death. The immobility of the right side of the face meant that the woman "was lying on her right side," and that was "where it choked up." He then quoted the Bible: "If thy right hand offend thee, cut it off." This indicated "separation from the woman." It was remarkable that the patient retained delusional ideas and totally rejected the fact of illness at a moment when his demise was so imminent. The threat of annihilation apparently had little influence on fantasy formation and failed to restore any rational thinking.

*Summary:* (Figs. 3 and 4) A quiet, passive, rigid, unimaginative individual in a setting of a serious chronic disease, which prevented any type of motor expression and which followed two periods of almost fatal respiratory paralysis, became depressed and developed complex delusional formations. Numerous psychopathological mechanisms were evident, including abnormal identification, projection, fantasy formation, abstruse symbolization, rationalization, compensation and overt and repressed hostile impulses. His illness was characterized by ideas of power, omnipotence and persecution; irritability and outbursts of anger; rebirth fantasies; evidence of latent homosexual tendencies and mystical preoccupation with the significance of opposites. Ambivalent attitudes to himself, to his illness and to his wife were prominent.

It was probable, from the size of the head and from roentgenographic studies, that hydrocephalus had occurred, although no history of birth trauma could be obtained. Two severe injuries had occurred at the ages of 19 and 36, the first of which had left as a residual a left peripheral facial paralysis and the second had precipitated the syndrome of myasthenia gravis. Following the death of his mother when he was 15, the patient developed a moderate depression for five years with a temporary exacerbation at the age of 18, coincident with an explosion in an arsenal in which he worked. Psychological tests, such as could be applied, indicated diffuse mental disorganization. During his stay in the hospital, coincident with emotional outbursts, both his somatic and psychic symptomatology became intensified, with numerous episodes of respiratory paralysis and expansion of a loosely constructed delusional system and megalomanic development.

## Discussion

### Influence of the soma on the psyche

The relations between sensations, motility, affect, and content were with difficulty understood but certain effects of somatic symptomatology on process of mentation appeared evident. The fatigability of the muscles of articulation had a part in the formation of a

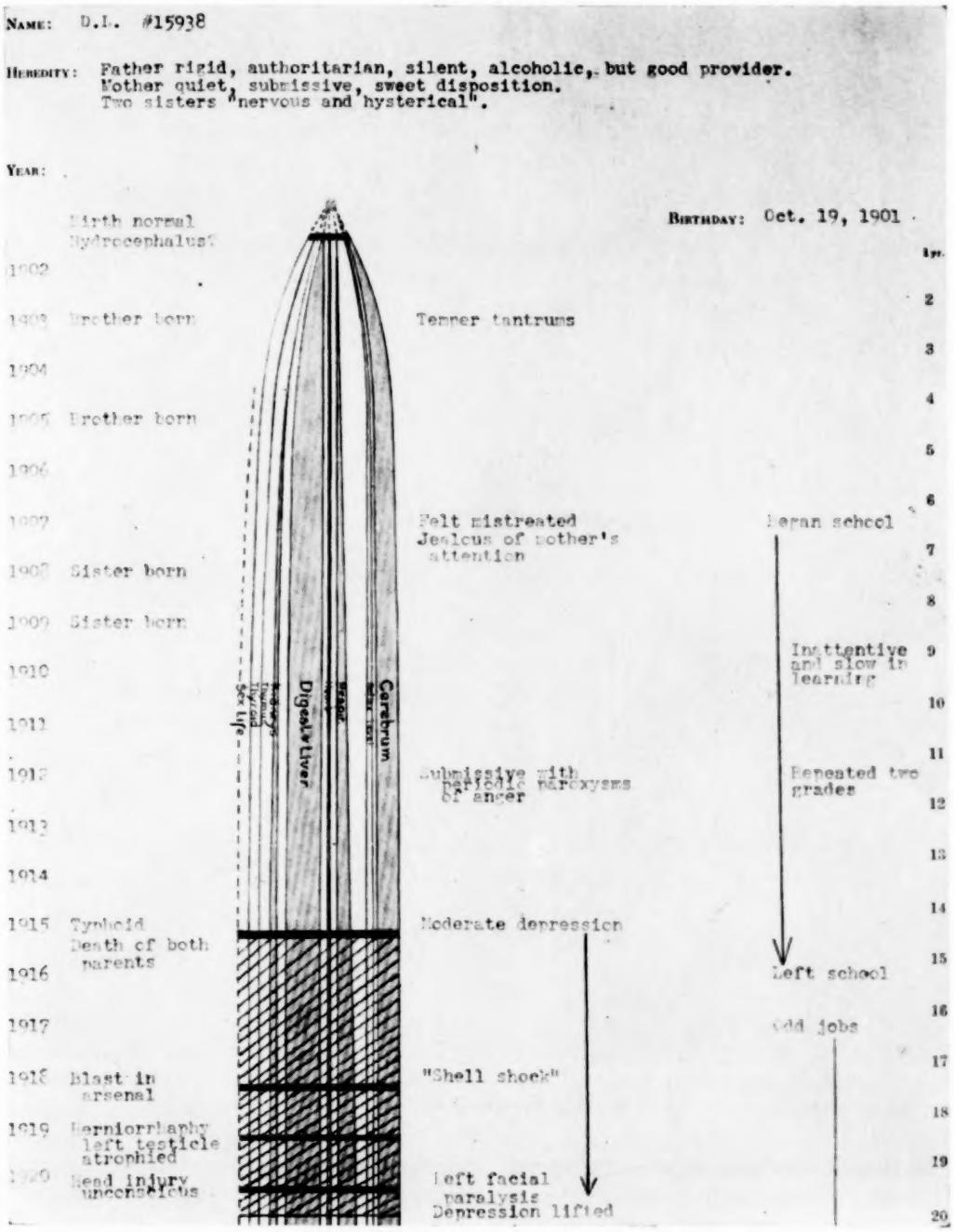


FIG. 3. Life chart of D. L. (Adapted from the life chart used in the Henry Phipps Psychiatric Clinic, Baltimore, Md.)

delusion which permitted communication in a telepathic manner without the necessity for the vocal expression which was so fatiguing for the patient. The weakness of the muscles of the arms caused him to drop food and utensils, which was attributed to Divine intervention preventing the consumption of poisoned food. The diplopia was explained by the assumption that he

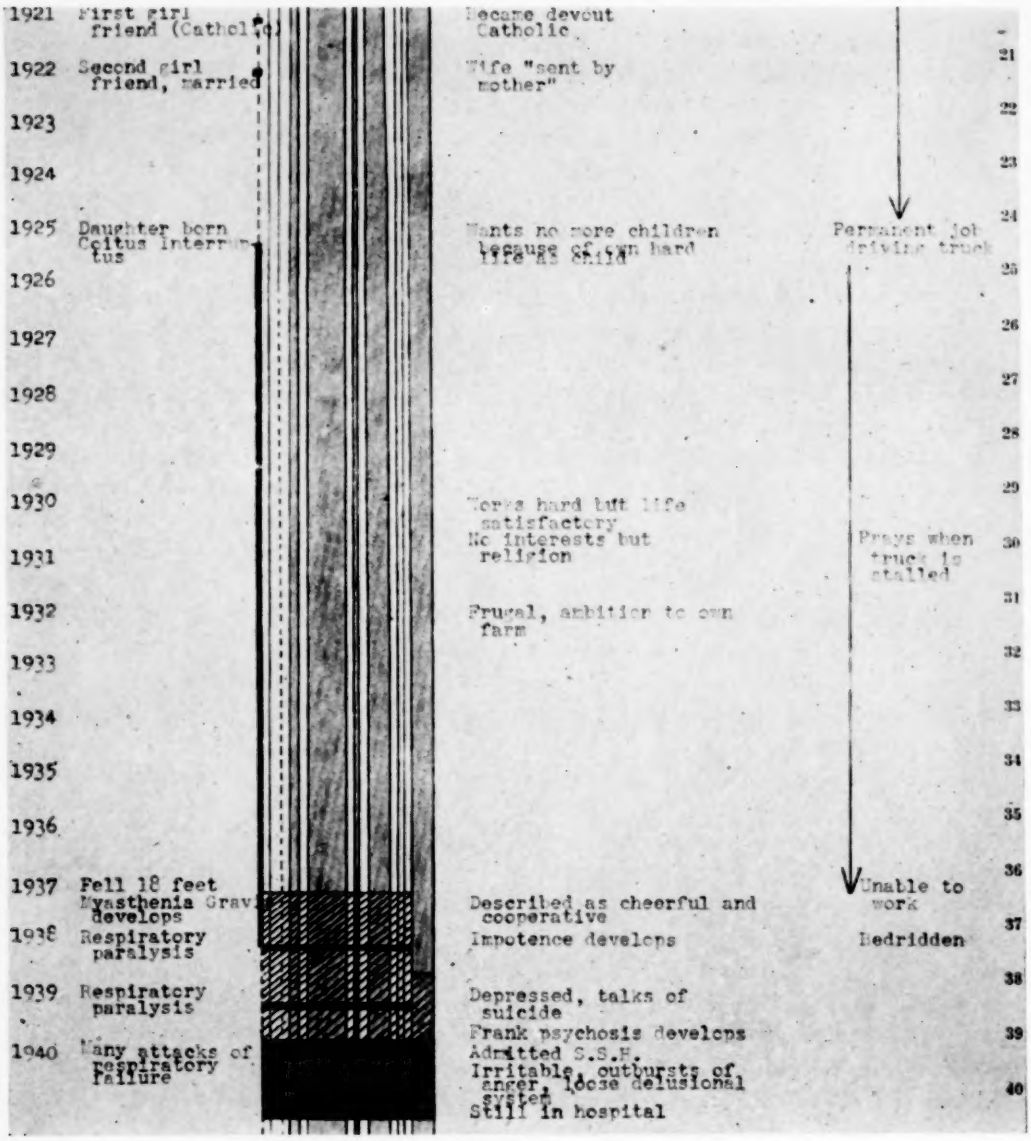


FIG. 4. Life chart of D. L. (continued).

was two individuals in one, and therefore was given double vision. His attacks of dyspnea and cyanosis were solely to demonstrate how a person would act in such a situation. From the periods of respiratory paralysis also, he developed rebirth fantasies, and his helplessness further strengthened his impression that he was a weak infant occupying an adult body, and therefore unable to utilize it. Psychic phenomena compensatory for the disabling illness were evident in his assumption that God had taken him out of his usual pursuits and stricken him with immobility in order that he might diffuse knowledge throughout the world from a central point. Coincident with these delusions, however, the patient was unable to accept the fact of illness and consistently refused treatment. His preoccupation with the problems of life

and death was understandable since he was on the borderline on many occasions, yet it is strange that even in his most severe attack he betrayed no apprehension and projected the actual respiratory paralysis to another individual; almost, in his case, a denial unto death. Apparently, the immobility was a somatic substratum of the regressive phenomena exhibited by the patient.

This description of the psychic reflections of somatic determinants is interesting in the light of the work of Deutsch (*7*), who, in investigating free association, found that somatic sensations mingled with the ordinary associations and that seemingly irrelevant somatic sensations had meaning and formed an inherent part of the existing psychic situation. Vague sensations, possibly the result of autonomic and physicochemical imbalances, constitute an internal reality which is misinterpreted and externalized. Whether gustatory and olfactory dysesthesias and disordered somesthesias and visceresthesias in this way contributed to the passivity feelings and ideas of poisoning, there is no evidence, but some authors (Buzzard, *4*, Markeloff, *15*) have reported segmental sensory changes and diminution in auditory acuity and in the senses of taste and smell. As shown in the behavior chart, there was a parallelism in the severity of both the mental and somatic symptoms, although it is uncertain whether pathophysiologic changes intrinsic to the disease were responsible for both these groups. The early hydrocephalus, the previous traumata with their possible lesions and the episodes of respiratory paralysis with their consequent repeated cerebral anoxia are other factors which may have played a rôle, but these are conjectural. Encephalography, although indicated, was prohibited by the patient's precarious organismal balance.

INFLUENCE OF THE PSYCHE ON THE SOMA

It is a well known fact that emotions are expressed in bodily changes and are mediated largely through vegetative-endocrine integrations (Dunbar, *8*). The respiratory mechanism is especially readily influenced by emotional factors and is one of the most delicate indices of fluctuations in affective tone. This is comprehensible in view of the innervation of the diaphragm which is one of the few striped muscles subject to the vegetative system. In myasthenia gravis the diaphragm is affected by the same pathophysiological changes as the rest of the skeletal muscles but must of necessity remain in constant activity. It is, therefore, the most susceptible muscle involved and the majority of the fatalities in this disease are the result of respiratory paralysis. Accordingly, it is understandable that the patient's emotional upheavals should have an immediate and noxious influence on the respiratory mechanism.

The patient's mood was predominantly one of irritability with frequent outbursts of anger occurring on the slightest provocation. Motor expression of affective impulses was impossible because of the weakness of the muscular system and these were mainly verbally manifested. Dunbar, *9*, quotes Sherrington to the effect that the greatest relief of psychic tension is in action, next in speech and last in fantasy and thought. If all action is suppressed the development of psychic or somatic symptomatology or both is favored. It is possible in the case of D.L. that the "chemism" of anger, unable to express itself through the muscular system, does so in a deleterious way on other organ systems. It has frequently been observed (Collins, *6*, Keschner & Strauss, *13*, Levi, *14*, Markeloff, *15*) that overactivity has a serious effect on the symptomatology of myasthenia gravis and Allers and Scheminzky (*1*) have

indicated that not only motion but ideas of motion produce the physical, chemical and electronic changes of action currents. There has also been experimental evidence to indicate that mental fatigue increased muscular fatigue. Such findings make it appear possible that even the tendency to action provoked by the patient's outbursts of anger might have a pernicious effect on his symptoms. Immediately after the paroxysms of rage, respirations and pulse would fluctuate widely, respiratory excursions gradually diminish and cyanosis finally ensue. In addition to the episodes precipitated by anger, a severe attack of respiratory paralysis occurred with an access of depression and the jerky respiratory movements in weeping. The life of this patient surely "was at the mercy of any rascal who chose to annoy him." This condition could be alleviated by isolation of the patient and withdrawal of all stimuli or by the administration of prostigmine. Only at rare intervals, because of the patient's suspicions and delusional ramifications, could sufficient rapport for psychotherapeutic efforts be obtained.

Saul (*18*) has indicated the rôle of repressed hostile aggressive impulses in essential hypertension and gives the elements of the conflict situation in such patients as: 1. A masochistic submissiveness and an oral dependent attitude and 2. Chronic unsuccessful rebellion and hostility to this submission with unconscious homosexual tendencies. Dunbar (*9*) too, has mentioned a marked attachment to the mother and a fear of the father. In the case presented there is a similar psychopathological situation and there is moreover, an essential hypertension with a lability of blood pressure. It is probable, however, that such factors affect not only the vasomotor reactions but the vegetative-endocrine system as a whole and it is of some interest that there were slight disorders in the lipoid and carbohydrate metabolism in 1938; furthermore, there was more severe impairment of carbohydrate metabolism manifest at this time. (See laboratory studies.)

These problems are intimately bound to the sympathetic and parasympathetic nerve balance and that of the adrenergic and cholinergic substances which mediate their nerve impulses. In an intense emotion such as fright, adrenergic responses are presumed to have a generalized action to prepare the organism for motor activity. At the same time, more local cholinergic responses occur which are concerned with the actual muscular contractions. The substances to a certain extent have an antagonistic action and Bender (*2*) has recently demonstrated that epinephrine inhibited contractions in denervated muscles obtained by fright or acetylcholine. Myerson, Loman and Dameshek (*16*) have shown that intravenous administration of epinephrine gave effects which overshadowed those produced by the simultaneous administration of mecholyl. In the application of such investigations to the clinical observations cited, it is possible that adrenergic substances liberated during emotional outbursts exerted an inhibitory effect on an already damaged cholinergic mechanism. It is furthermore possible, although this is conjectural, that intermediary degradation products of these substances in metabolic disorders might have unpredictable but noxious effects.

## Summary

Psychosis developing in the course of myasthenia gravis is a rare occurrence. Such a case studied from the physicochemical, vegetative-endocrine, and psychobiological aspects is reported. The psychopathological and somato-

pathological components of the reactions of the total organism are considered and their interrelations discussed.

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# THE USE OF PSYCHOLOGICAL TESTS IN THE EVALUATION OF INTELLECTUAL FUNCTION FOLLOWING HEAD INJURY: REPORT OF A CASE OF POST-TRAUMATIC PERSONALITY DISORDER

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IN THE EVALUATION of the psychological status of a patient who has suffered a head injury, the determination of the presence or absence, and, if present, the degree of impairment of his intellectual functions is of prime importance. In cases of severe brain damage, in which neurological and psychological findings combine to form a clear picture of the post-traumatic defect state, this question is easily answered. In milder cases, however, in which neurological findings are either absent or ambiguous and in which the picture may be complicated by psychogenic factors, the problem is not so easily solved. Under the usual clinical examination, such individuals may appear to be suffering from no post-traumatic intellectual defects, despite their complaints to the contrary. However, special tests of intellectual capacity frequently indicate that a sound basis for their complaints exists in that definite defects in thinking processes, not detected by the usual clinical methods, are revealed.

The value of psychological tests in revealing intellectual defects which might otherwise remain unnoticed has been pointed out by many workers. Gross and Ehrlich, discussing the post-traumatic syndrome, point out that "psychological investigations carried out on many patients recovering and convalescing from acute head injuries show that even among those with no apparent mental defect clinically, there is a demonstrable impairment in mental processes, particularly evident when the patient is required to perform tasks necessitating abstract thinking." (*16*, pp. 226–227). Conkey (*9*) has shown that intellectual defects can be demonstrated by psychological tests long after physical symptoms have disappeared. Bowman and Blau, discussing post-traumatic defect conditions, state that "in adults, the demonstration of many of these losses requires careful examination with psychological tests except in the few cases with obvious gross disturbances." (*7*, p. 339) Straus and Savitsky, in their discussion of head injury, state that "the usual psychiatric examination is incomplete and will detect only the most evident defects." "More attention should be paid by neuropsychiatrists to the methods of investigation developed by experimental and clinical psychologists in the study of head injuries and their sequelae." (*29*, pp. 909, 955).

The purpose of this paper is to demonstrate the use of certain psychological tests by showing their application in the evaluation of the intellectual status of a patient who had suffered a head injury and in whose case it was difficult to estimate clinically the degree and nature of intellectual impairment. These tests will be described, their merits and limitations noted, and the pertinent

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literature reported in some detail in order to show the factual basis for their application in the present case. The patient's performances on the tests will be described and discussed.

## Case Report

The patient was a man of 52 years, of Russian-Jewish descent, born in Poland. His condition at birth and early development were reported to have been normal. He had little formal education. As a child, he was active and sociable and was a leader among his playmates. When he was 18 years old, he emigrated to the United States. After he had been in the country two years he opened his own business as a house painter. His business grew so rapidly that in a relatively short time he had 50 workers in his employ. After six years he changed his business to that of contracting decorator. He continued in this field up to the time of this report and had been unusually successful.

He was married at the age of 34 years to a girl whom he had known for eight months. He had three children toward whom he was always affectionate and demonstrative. He was unable to live happily with his wife and they separated seven years before the time of his accident. Concerning this he said, "They ask me whose fault it was and I say, 'Well, it wasn't mine.' " About that time he began to drink rather heavily. "I had been drinking for a while. Most of my friends drink. I gave it up when I thought I was throwing my life away on liquor."

He was always quite active and possessed a good deal of drive. As an outlet for his excess energy, he was interested in the raising of fine stock as a hobby. He was active socially, attending card parties and dances up to the time of his accident.

In the fall of 1939, he felt rather lonely after his youngest child had left home for the first time to attend military school. During the afternoon of the day the accident occurred he had one or two glasses of wine at a luncheon with some friends. It was on his drive home from this luncheon that the accident occurred.

*Accident:* While driving at a high rate of speed (*circa* 70 miles an hour), he thought he heard a car horn behind him. Turning his head to investigate, he lost control of his car. He awakened in a hospital, having been unconscious for about 24 hours. He complained of severe headache, generalized abdominal pain, dizziness and nausea, but there was no history of vomiting. He was quite apprehensive and unable to give details of the accident.

*Physical Examination:* No abrasions or contusions of the head were apparent. There was no bleeding or discharge from the ears or nose. There was posterior tenderness of the neck and generalized acute tenderness of the abdomen without rigidity. Physical and neurological examination was otherwise essentially negative.

*Laboratory Reports:* Blood and urinalysis were essentially normal. X-ray report four days after accident—examination of the skull showed no evidence of fracture. Examination of the lower dorsal and lumbar spine showed moderate lipping of the anterior margins of the vertebrae indicating a mild arthritis. There was no evidence of fracture or dislocation.

*Course in Hospital:* He regained his strength rapidly and after five weeks left the hospital. At home he continued to improve for a short time but then felt worse and went to a psychiatric hospital. After eleven weeks in this hospital he showed some improvement. The outstanding symptoms were insomnia, depression, anxiety and complaints of severe headache. He was discharged upon his own insistence, giving as a reason that he was too far from home and his children. A diagnosis of post-traumatic anxiety state, condition improved, was made. He was subsequently admitted as a voluntary patient to the New York Hospital-Westchester Division-twenty-eight weeks after his accident.

Upon admission he was direct, frank and friendly in manner. He complained of pain in the back, weakness in the legs (he walked with the aid of a cane), and headaches. His vision was blurred at times. He had lost his drive and become quite depressed.

*Physical Examination:* Temperature 98.8, pulse 84, respirations 20. The head was of normal size and shape; the hair was dark but graying at the temples; the features were symmetrical. Body hair was sparse but

of masculine distribution. External genitalia were normal in size and appearance. There was no tenderness or scars over the sinuses or mastoid processes. No lymphadenopathy was present. The thyroid was not palpable. Mucous membranes were clear. The tongue was slightly coated. The teeth were stained but in good repair. The pharynx was clear, the tonsils atrophic. The apex beat was neither seen nor felt. To percussion, the left border of the heart was 7 cm. to the left of the midline, the right border behind the sternum. There were no murmurs or friction rubs present. Rate and rhythm were normal. $P_2$ was greater than $A_2$. The radial pulse was synchronous with the apex beat. The walls of the radial arteries were definitely palpable. Blood pressure 112/78. Voice was that of a normal male adult. The chest was normal to inspection, palpation, percussion and auscultation. The abdomen was scaphoid. Masses of feces could be felt in the descending colon. There was a healed scar about 4 inches long and $\frac{1}{4}$ inch wide over McBurney's point. There was an inguinal hernia about $1\frac{1}{2}$ inches in diameter on the right side which transmitted abdominal pressure. The liver, kidney and spleen appeared to be of normal size, shape and position. He was able to distinguish the odor of peppermint and cloves with either nostril. Vision: O.D. 20/60, O.S. fingers at 3 feet. There were no corneal scars and the lenses were clear. The pupils were round, regular and equal. Reaction to light and accommodation was present. Eyegrounds: The discs were pale. There was silver-wire reflex from the retinal arteries. External ocular movements were normal. The tongue protruded in the midline with no tremor. Muscular strength appeared normal. Gait was slow and unsteady. Coordination in the finger-to-nose and heel-to-knee tests was good. Sensibility to touch, pain, heat and cold was normal. Stereognosis was normal and there was no nerve tenderness. Vasomotor and trophic conditions appeared normal. There were no abnormal involuntary movements. Reflexes were hypotonic but equal on the two sides except for absent Achilles on the right. The Babinski and Romberg were negative. Blood cytology, serology and chemistry were normal. Urinalysis was negative.

He was adaptable and cooperative and no disorder in his stream of mental activity was apparent. Answers were relevant, coherent and readily given. Emotional reaction was found to be that of *depression.* At times he was rather seclusive and irritable. He was hypochondriacal and stated that he frequently experienced unreality feelings. Recurring thoughts, accompanied by anxiety, which consisted of memories of dangerous experiences in the past, *e.g.*, his evasion of military service in Poland, were present.

He was oriented for time, place, person and situation. Remote and recent memory were good. However, retention was rather poor (5 digits forward, 5 digits reversed, word pairs test done rather poorly). Examining physician felt that the poor performance on retention tests might have been due to lack of concentration. Counting and calculation were accurate but slow. Reading was slow, halting and expressionless. Writing was slow and constrained but no tremors, elisions or transpositions were present. School and general knowledge seemed poor but not extraordinarily so in view of the patient's meagre education. Intelligence level appeared to be that of an average or superior adult. Practical judgment appeared to be good.

He stated that he did not wish to have to deal with any business problems until he was well, stating that he was unable to concentrate or even think about it. He improved rapidly during the first two weeks of his hospitalization. He was generally less depressed, his appetite was fair and he slept fairly well without medication. He no longer found it necessary to walk with the aid of a cane. During the third week of hospitalization, he continued to improve steadily. He extended the length of his walks, found that he could read the newspaper and retain some of its contents. It was at this time, thirty weeks after the occurrence of his accident, that some of the tests to be described were given to him. His improvement continued during the ensuing seven weeks, although he continued to have spells of depression. He became more active, was optimistic about the possibility of recovery and was planning to leave the hospital. At

the end of this period, thirty-seven weeks after the occurrence of his accident, psychological tests were again given to him. The following week he decided to leave the hospital, giving as a reason the fact that he felt it his duty to spend some time with his younger son who was home from school. He planned to go on a fishing trip with his son. He showed considerable improvement, his physical energy had shown marked gains, his fatigability was less rapid and less extreme than it had been and mood was in general one of optimism. He felt gratified with the progress he had made while at the hospital.

Five weeks after discharge from the hospital, he called on his physician. He was feeling somewhat depressed and was undecided as to the advisability of further hospitalization.

## Analysis of Test Performances

In the test situations, the patient was cooperative, showed a high level of effort but appeared to fatigue easily. He was interested in the quality of his performances and tended to be irritated by failure. He was inclined to give excuses for his failures, *e.g.*, when he failed to complete one of the designs of the Kohs Test, he ascribed it to his "sensitiveness" at having the examiner watch his performance. After failing another design, he said that he was sure he could do better in the afternoon than in the morning. After failing another design, he complained that he was getting tired.

In order to obtain a satisfactory index of his *maximal* mental efficiency and to insure that his test performance would not be disturbed by a diminished *work-capacity*, the test sessions were relatively short. A first session, 30 weeks after the occurrence of his accident, was 40 minutes in length. A second session, 37 weeks after the occurrence of his accident, was 31 minutes in length. A third and a fourth session, 37 weeks after the occurrence of his accident, were each 22 minutes in length.

### I. Vocabulary Level and Information Range as Indicators of Probable Pre-Morbid Intelligence Level

Thirty-seven weeks after his accident, the patient was given the vocabulary test of the Shipley-Hartford scale (*26*, *27*). On this test, his raw score was 26 words, corresponding to a "mental age" of 15 years, 6 months, which is roughly average adult performance.

In evaluating the significance of this performance, two facts may be considered. The first point is that (in dealing with normal individuals) vocabulary level in itself was found by Terman and Merrill (*30*) to be the best single measure of general intelligence in the Revised Stanford-Binet scale. Wechsler (*32*) also found it to be an excellent measure of general intelligence. Secondly, numerous investigators (*1*, *11*, *12*, *28*, *31*, *32*, *36*) have confirmed the fact, first noted by Wells and Kelley (*35*), that vocabulary level tends to remain stationary or to decline relatively slightly in cases where organic and schizophrenic impairment of intellectual function or "deterioration" occurs.[1] This appears to be true not only in pathological cases but in the normal decline of intellectual abilities with age (*13*, *19*, *31*, *32*). If we could accept these propositions and unqualifiedly apply them to the present case, we would conclude from the patient's performance that his *pre-traumatic* level was probably average. However, we know that the patient's native language was not English and that he received no education in this country. Under these conditions, the question might justifiably be raised if the measure of vocabulary level does not underestimate somewhat the patient's pre-traumatic intellectual level. The question is an open one and the only safe conclusion that can be made is that the patient's pre-traumat-

[1] The exception to this general rule appears to be idiopathic epilepsy (*8*).

ic intellectual level was probably *at least* average.

On the same day, the patient was also given the information test of the Bellevue Intelligence Scale (*32*). On this test, his raw score was 13, corresponding to average adult performance. This type of test has the same characteristics as the vocabulary test in that it is a fairly good measure of the general intelligence of normal individuals (*32*) and it does not appear to be markedly affected in cases of organic impairment of intellectual function (*34*), or in the normal decline of abilities with age (*19, 31, 32*). Accordingly, we may conclude that the patient's performance on this test indicates that his pre-traumatic intellectual level was at least average. This conclusion is in harmony with the history of successful business achievement.

II. WEIGL COLOR-FORM SORTING TEST (*33*)

Thirty weeks after his accident, the patient was given this test which consists of 12 cardboard figures of different form and color—four circles (red, green, yellow, blue), four squares (red, green, yellow, blue) and four equilateral triangles (red, green, yellow, blue). The figures are placed in random order in front of the subject and he is instructed to put those together that belong together. If the subject asks whether he should put those of the same form or color together he is told to do whichever he prefers. After he has sorted the figures in some way, he is asked why they belong in that way. If the subject is unable to carry out any type of sorting or does not grasp the instructions he is told to put those objects together which are *alike* in some way. After the subject has sorted the figures, they are replaced in random order and the subject is requested to put them together in another way.

Weigl found that normal subjects were able to sort the figures on the basis of a clear-cut characteristic such as form or color. Further, after having sorted them on the basis of one common characteristic, *e.g.*, form, they had no difficulty in shifting their set and sorting on the basis of another clear-cut characteristic, *e.g.*, color. Normal individuals are able to adopt an "abstract attitude" toward the task, *i.e.*, they are able to search for and to abstract a single characteristic out of the figures, *e.g.*, color, and to proceed to sort the figures on the basis of this common characteristic, ignoring other factors such as form or general arrangement. Patients with cerebral lesions, on the other hand, frequently were unable to adopt this active, searching "abstract attitude" in meeting the instructions. Having sorted the figures in some way, they had difficulty in stating the basis for their sorting. When the figures were replaced in random order and they were requested to sort them in a different way, they tended to perseverate with the initial type of grouping, betraying a rigidity in mental set or "incapacity to shift attitude." Bolles and Goldstein (*4, 5*) found that mental defectives and deteriorated schizophrenics showed an inability to shift their attitude or set voluntarily and proceed from the point of view first taken when requested to sort the figures in a different way. Normal children of the same "mental age" as these defectives and schizophrenics were quite able to shift from one attitude to the other voluntarily and they were able to verbalize the basis of their classifications successfully.

The test provides the opportunity to observe if the subject is able to carry on simple reasoning in a novel situation. Given his instructions, can he perceive a *common* characteristic in the figures, *i.e.*, form or color, and, having perceived this characteristic, can he act

in accordance with this perception without being distracted by other characteristics of the figures?

When our patient was presented with the cardboard pieces and asked to put those together that belong together, he was at a loss and asked for more definite instructions. He was told then to put those figures together which were alike in some way. He was unable to proceed even on the basis of these instructions. After a length of time, when it seemed clear that the patient could not perceive spontaneously a common characteristic of the figures or at least to make such a perception a guide for performance, the examiner suggested the characteristics of "shape." The patient immediately grasped this idea and proceeded to sort the figures on the basis of form or "shape." When asked the basis for his sorting, he hesitated, then said "according to cut." When asked to sort them in another way, he appeared again to be at a loss. The examiner then said, "They differ according to cut. In what other ways are they different?" This brought forth no response from the patient. The examiner then separated the red and blue circles from the other figures and asked the patient how these differed. The patient immediately grasped the fact that they differed in color, sorted all the figures on the basis of color, and, when asked the basis for his sorting, stated it correctly.

The patient's performance indicated that, while he showed no *absolute* inability to utilize concepts or to think in abstract terms, he suffered from some impairment of function in this respect. He was unable to think *spontaneously* in simple abstract terms; an essential characteristic of the figures such as form or color had to be pointed out to him before he grasped it. His was not the performance of a normal adult of average intelligence and it was considered, in view of his history, as suggestive of a post-traumatic impairment of intellectual function.

### III. OBJECT SORTING TEST

Thirty-seven weeks after his accident, the patient was given the "Object Sorting Test B" of Bolles (*4*), which consists of 31 objects which can be classified on a variety of bases—size, color, use, material, etc. These objects are placed in random order before the subject. The examiner asks whether the subject knows what all the objects are and names any object with which the subject is not familiar. In the first part of the test, each of six objects is presented by the examiner with the instruction to the subject to put together with it all those objects from the total group which he thinks belong with it. After he has done this, he is asked why the objects belong together. In the second part of the test, groups of objects belonging to a single category or having a common characteristic, *e.g.*, a group of round objects, red objects, metal objects, tools, etc., are placed before the subject and he is asked to tell why they belong together.

In general, three types of behavior are observable in the first part of the test. When presented with an object and asked to put together all those objects which belong with it, the subject may fail to detect any kind of relationship between the presented object and any of the other objects and definitely state that nothing belongs with the presented object. This type of behavior is observed frequently in mental defectives (*4*), occasionally in patients with cerebral lesions (*33*), rarely in normal subjects (*4*). Secondly, when presented with an object and asked to put together all those that belong with it, the subject may make a grouping that is concrete in nature, *i.e.*, a grouping that he has seen before in a concrete situa-

TABLE 1

BEHAVIOR OF PATIENT ON OBJECT-SORTING TEST

*Part I*

| Object Presented | Objects Chosen by Patient To Be Included with Presented Object | Reason Given by Patient for Choice of Objects | Classification of Response |
|---|---|---|---|
| 1. Large fork | Knife; spoon, and toy Spoon | "Knife to cut; use with fork; this (spoon) you use with other parts of meal" | CONCRETE |
| 2. Pipe | Match | "You light with a match—the pipe" | CONCRETE |
| 3. Bicycle bell | (None) | | FAILURE |
| 4. Red cardboard circle | Yellow cardboard square | "Both cardboards" | ABSTRACT |
| 5. Toy pliers | Toy screwdriver<br>Toy hammer | "Both tools—same size" | ABSTRACT |
| 6. Rubber ball | (None) | | FAILURE |

*Part II*

| Common Characteristics of Group of Objects Presented | Response of Patient |
|---|---|
| 1. Red objects | PASSED |
| 2. Round objects | FAILED |
| 3. Metal | PASSED |
| 4. Tools | PASSED |
| 5. White objects | FAILED |
| 6. Square objects | FAILED |
| 7. Paper objects | PASSED |
| 8. Smoking materials | PASSED |
| 9. Rubber objects | PASSED |
| 10. Toys | FAILED |

tion or that might be used in a concrete situation, *e.g.*, knife, fork and spoon to be used at the table, or a pipe, matches and a spoon, the spoon to be used to scratch out the pipe. It has been found that in patients with cerebral lesions and in deteriorated schizophrenics concrete groupings of this type are made far more frequently than in normal subjects (*4*, *5*, *33*). Finally, when presented with an object and asked to put together all those that belong with it, the subject may make a grouping on the basis of some common characteristic or because the grouped objects belong to a single category. This third type of grouping, which is essentially a *classifying* of the objects, involves the processes of abstraction and generalization which the first and second types of behavior do not involve. This is the type of behavior which is seen more frequently in normal subjects than in patients with cerebral lesions or in deteriorated schizophrenics. It has also been noted by Halsted (*17*) that in spontaneous sorting of this type, patients with frontal lobe lesions select *fewer* objects for grouping than do normal individuals.

In the second part of the test, when presented with a group of objects having a common characteristic or belonging in a single category, and asked why they belong together, the patient reveals whether or not he possesses the capacity to abstract and generalize in this situation. This is a situation in which patients with cerebral lesions, mental defectives and deteriorated schizophrenics frequently fail, normal subjects almost never (*4*, *33*).

Our patient's behavior on this test can be most conveniently presented in tabular form (Table 1).

It will be noted that in the first part

of the test, the spontaneous sorting, absolute inability to group objects occurred in two instances. As noted above, this type of failure occurs rarely in normal individuals. In the four instances where objects were grouped, groupings of a concrete type occurred in two instances. Finally, it will be noted that the number of objects grouped was quite small, which is characteristic of patients with frontal lobe lesions. For example, in the first grouping, although a toy spoon was included in the selected group, a toy knife and a toy fork were neglected. In the second grouping, a match was selected to go with a pipe, while a cigar and a cigarette were neglected. In the second part of the test, he failed to perceive the fundamental basis of the group of objects presented in four instances. As noted above, normal individuals almost never fail on this type of task.

The patient's behavior on this test was decidedly closer to the pathological than to the normal. His relative inability to abstract and generalize was shown clearly on this test as on the other tests. In addition, what might be termed a "poverty of association" or "lack of associative energy" is manifested.

### IV. RORSCHACH TEST (*2*, *25*)

The Rorschach Test, a sensitive indicator of the intellectual and emotional status of an individual, has been applied to neurological conditions as well as to neurotic and psychotic states. Oberholzer (*22*), in a detailed Rorschach study of a patient who had suffered a head injury, emphasized the usefulness of the test in the differential diagnosis of post-traumatic conditions and pointed out the various Rorschach "signs" (low F+ per cent, high A per cent, numerous DW's, lengthening of reaction time, perseveration of responses, lack of movement responses, lack of good W responses) which are the manifestations of a post-traumatic defect state. Piotrowski (*23*, *24*) has investigated the Rorschach performances of patients with brain lesions, has listed 10 "signs" of abnormality (number of responses less than 15, average time per single response of more than one minute, no more than one movement response, at least one color denomination, F+ per cent less than 70, percentage of popular responses below 25, giving same response to several inkblots, giving a response in spite of recognition of its inadequacy, perplexity associated with doubts of ability, automatic phrases) and has suggested that "if the Rorschach record of an adult contains at least five of the ten tabulated signs, it can be considered as pointing to the existence of an organic disease process which involves the brain" (*23*, p. 533). Harrower-Erickson has reported on the Rorschach performances of patients with brain tumor and pointed out their performances "show restricted and constricted personality, extraordinarily uniform when contrasted with the variety found in the records of normal subjects" (18, p. 889). Specific findings in this group of cases were 1) low number of responses, 2) low F+ per cent, 3) high percentage of form responses with correspondingly few movement and color responses.

Our patient was given the Rorschach Test twice, the first time thirty weeks and the second time thirty-seven weeks after his accident. His records are given in Table 2.

The Rorschach performances indicated an individual of low intellectual capacity whose interpretations and judgments were simple, crude, and frequently inaccurate. Approach was nonanalytical, reaction was uncritical, and a poverty of associational energy was shown. While capacity for mature, so-

cialized emotional experience was shown, this was overweighted by a tendency toward egocentric and irrational emotional reaction.

The performances were considered by the writers as evidence for the existence of impairment of cerebral function in the patient. In order to check on this interpretation, Dr. S. J. Beck was asked if he would make an independent evaluation of the records. Dr. Beck kindly consented to do this and sent the following diagnostic summaries:

*Rorschach I.* "In the intellectual sphere patient shows a poor grasp of reality, somewhat below that found in the healthy (F+%); an uncritical approach to his problems (DW); simple mentality so far as

TABLE 2

Rorschach I (30 Weeks after Accident) Time: 13 minutes

Note: Identifications of part of blot chosen for interpretation follow the system of Beck (*2*).

| *Time before 1st Response* | *Responses* | *Scoring* |
|---|---|---|
| | I | |
| 17″ | Like a bee, like (smiles, tells examiner he has a farm; in inquiry points out wings D12; and honeypocket D2 and Dr3). | W F+A 1.0 |
| | II | |
| | I wouldn't connect this with anything; what is it supposed to resemble? I can't see what it reminds me of. | D F+A 3.0 |
| 69″ | It could be like two animals, paw to paw (in inquiry points out D24; "They're like tails, you know, from a decorative angle"; tails refer to Dr9). | |
| | III | |
| 32″ | Like a human skeleton? (Meaning assigned to whole blot; in inquiry points out D15 as "intestine like" and D4 as "legs"). | DW F−Anat |
| | IV | |
| 101″ | Can't think of anything it'll remind me of. Like a split fur or something, doesn't it? (In inquiry says "some kind of an animal, open"). | W F+A P 2.0 |
| | V | |
| 30″ | Butterfly (in inquiry points out head D9). | W F+A P 1.0 |
| | VI | |
| 25″ | Some kind of a fly, is it? (Meaning assigned to whole blot; in inquiry points to "whiskers" Dr2, when asked what reminded him of fly). | DrW F−A |
| | VII | |
| 92″ | Can't see any resemblance to anything I can match up. What would you . . . ? (Examiner: What would you say it was?) I don't match it up with anything to be frank. | FAILURE |
| | VIII | |
| 17″ | Some kind of an ornament with animals on (in inquiry points out animals "Standing up"). | W FC+Art 4.5 D F+A P |
| | IX | |
| 38″ | Hm (smiles). This looks to me like hams (laughs); that's silly (D27; "just talking foolish, it looks like hams"; indicates that color is primary influence). | D C, Food |
| | X | |
| 22″ | Looks like a lobster, isn't it? (Meaning assigned to whole blot; in inquiry says "all messed up"; "lobster split in two"; when asked what reminded him of lobster, points to D4). | DW F−A, Food 5.5 |

*SUMMARY*

No. 10
Failures 1

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| W | 4 | F | 8 (−3) | H | 0 | Z: 17 | F+ | 63% |
| DW | 2 (−2) | M | 0 | Hd | 0 | App: W: DW | A | 70% |
| DrW | 1 (−) | FC | 1 | A | 6 } 7 | | P | 3(30%) |
| D | 3 | CF | 0 | A, food | 1 } | | M:ΣC= | 0:2 |
| | 10 | C | 1 | Ad | 0 | | | |
| | | | 10 | Anat | 1 | | | |
| | | | | Food | 1 | | | |
| | | | | Art | 1 | | | |
| | | | | | 10 | | | |

Rorschach II (37 Weeks after Accident) Time: 10 minutes

| *Time before 1st Response* | *Responses* | *Scoring* |
|---|---|---|
| | I | |
| 7″ | Like a bee. | W F+A 1.0 |
| | Say a fly, wings (in inquiry says that D2 and Dr3 reminds him of fly). | W F−A 1.0 |
| | II | |
| 35″ | Looks like two animals, paws together (I've painted them many a time (D24) (Animals seen as headless)). | D F+A 3.0 |
| | III | |
| 11″ | Skeleton of a body or something (in inquiry says that D5 looks like kidneys). | DW F−Anat |
| | IV | |
| 27″ | Split fur of some kind (two halves of a fur). | W F+A P 2.0 |
| | V | |
| 5″ | Fly or something (in inquiry is unable to state what reminded him of fly). | W F−A 1.0 |
| | VI | |
| 8″ | Fly of some kind; a bee (in inquiry says "like a fly"; points out "head" of object D4; meaning assigned to whole). | DW F−A |
| | VII | |
| 10″ | This I can't tell, looks like blotches (ready to return card; is persuaded to look at it again).<br>Just blotches, has no relation to anything. | FAILURE |
| | VIII | |
| 10‴ | Two animals, paws against.<br>Something, like paint; an ornament. | D F+A P<br>D C paint<br>W FC+art 4.5 |
| | IX | |
| 27″ | Looks like a split lobster or something; (D3 reminded him of lobster; meaning assigned to whole). | DW F−A, Food |
| | X | |
| 25″ | Can't say this reminds me of anything (returns card). | FAILURE |

No. 11
Failures 2

*SUMMARY*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| W | 5 (−2) | F | 9 (−5) | H | 0 | F | 44% | Z: | 12.5 |
| DW | 3 (−3) | M | 0 | Hd | 0 | A | 73% | App: | W:DW |
| D | 3 | FC | 1 | A | 7 8 | P | 2(18%) | | |
| | 11 | CF | 0 | A, food | 1 | M:ΣC | 0:2.0 | | |
| | | C | 1 | Ad | 0 | | | | |
| | | | 11 | Anat | 1 | | | | |
| | | | | Art | 1 | | | | |
| | | | | Paint | 1 | | | | |
| | | | | | 11 | | | | |

associational content goes (A%). Affectively, the experiences vary from a primitive, uncontrolled variety (C) to some at the mature controlled level (FC). Some influence of the uncontrolled affectivity is seen in the poor grasp on reality (F−) and in the alogical method (DW). Question of a depressed state is raised by the slow time and the rejections. But the affective fluidity (the color reactions) are inconsistent with findings in depressions. The indication of neurotic shock (in Figures II and IX) points to a reactive condition. The slow time, the poor reality grasp and intellectual method, together with the uninhibited affectivity fit in with findings in organic pictures. The conclusion from this first Rorschach is, therefore, that we have a simple personality to start with and there is some deterioration process as would be related to brain pathology. But there is also, at a more superficial level, a reactive condition."

*Rorschach II.* "Patient's condition as indicated in the second Rorschach is worse than in the first. To begin with, grip on reality is definitely poorer (F+%); secondly, there is a general impoverishment as compared even with the restricted first record. Two complete rejections now occur and what is more significant, they include Figure X, one of the most productive and

affect-stimulating in the test. In Figure VIII, in the first Rorschach, patient responded relatively quickly with a "simultan ganz"; in the second Rorschach there is only a gradual and uncertain development of this whole. In Figure IX he produces only an uncritical association (F−) on the second performance, as compared with a free affect reaction (C) on the first performance."

"The picture in general in the second Rorschach is of greater inhibition, although here too there is a suggestion of neurotic shock in the second figure. The complete rejection of Figure X is inconsistent with neurosis. The findings as a whole are now more consistent with indication of deterioration such as would be found in brain pathology. While the question of reactive elements cannot be entirely dismissed, it would appear that they play a relatively lesser rôle than even the superficial one they played the first time."

As will be seen from his diagnostic summaries, Dr. Beck concurred in our impression that the Rorschach performances of the patient indicated an impairment of function due to cerebral lesions. It will be further noted that the records contain several of the "signs" pointed out by Oberholzer (low F+ per cent, high A per cent, numerous DW's, lengthening of reaction time, lack of movement responses), that the first record contains five of Piotrowski's "signs" (number of responses, no movement responses, low F+ per cent, average time per response, perplexity), that the second record contains four of Piotrowski's "signs" (number of responses, no movement responses, low F+ per cent, low P per cent) and that both records are in agreement with the findings of Harrower-Erickson (low number of responses, low F+ per cent, high percentage of form responses.

### V. KOHS BLOCK DESIGNS (*20*)

Thirty weeks after his accident, the patient was given the Kohs Block Design test. This test, which was devised as a non-verbal test of "intelligence," consists of a series of colored designs which the subject must reproduce using blocks with sides of different colors. The models to be copied are one-fourth the size of the block-design which the subject must construct. To complete these tasks successfully requires that the subject be able to analyze the design into its constituent parts, *i.e.*, be able to imagine the blocks in the given designs, further that he be able to synthesize his impressions correctly in constructing the block-design copy and finally that he be able to appreciate the identity of two designs of different sizes. Modifications of the test to show the influence on patients' performances of such factors as comparative size of the designs and presence or absence of lines representing the separation between the blocks have been contrived (*4*, *5*, *21*). The test is of interest in the present case because it has been reported that patients with cerebral lesions affecting primarily the frontal lobes tend to do very poorly on it (*21*). However, it is also true that a small proportion of apparently normal individuals likewise do very poorly on the test (*3*).

Our patient's performance on the test was quite poor. He successfully completed only the first four designs within the time limits allowed. His "mental age," according to the test norms established for children, would be seven years, eight months. Thirty-seven weeks after his accident (seven weeks after the initial test), he was again given the test. This time the designs were presented upside down to minimize a possible practice effect. Again his performance was quite poor, being only slightly better than the initial performance. He successfully completed the first four designs, failed the fifth, successfully completed the sixth, failed the seventh, eighth and ninth designs. His "mental age," according to the test norms for children, would be seven years, eleven months.

His poor performance on this test may be considered as further evidence that he is suffering from a post-traumatic impairment of intellectual function. The fact that on the re-test thirty-seven weeks after his accident his performance was not significantly better than on the initial test thirty weeks after his accident suggests that no improvement in condition has occurred during this interval.

### VI. SHIPLEY-HARTFORD SCALE (*26*, *27*)

Thirty-seven weeks after his accident the patient was given the Shipley-Hartford scale for measuring intellectual impairment. This scale consists of two parts, the first part being the vocabulary test mentioned in Section I above and the second part being a test of abstract thinking. Intellectual efficiency is measured in terms of the *discrepancy* between an individual's score on the vocabulary test as compared with his score on the abstract thinking test. It was noted above that several investigators had found that in intellectual deterioration vocabulary level tends to remain constant or to decline only slightly in comparison with the degree of decline of other intellectual functions. This discrepancy in rate of decline of level of function has been utilized by several workers to furnish an index of the presence and degree of impairment of function (*1*, *12*, *13*, *26*, *28*, *31*, *36*). In the Shipley-Hartford scale, the level of a single function, abstract thinking, is compared with performance on a vocabulary test and the relationship between the two performances expressed in terms of a "conceptual quotient" (C.Q.). In an extensive study of normal subjects, Shipley found that 65 per cent had C.Q.'s of 86 or over and only one per cent had C.Q.'s below 66. In a study of private and state hospital patients, he found that "the median C.Q. of the private hospital group fell at the 14th percentile of the normals; that of the state hospital group (which was composed only of the better preserved cases) fell below the 1st percentile of the normals. In both groups the non-psychotics showed little impairment; the functional psychotics showed more, and the organic psychotics, most of all" (*27*, pp. 1–2).

As stated above, our patient's score on the vocabulary test corresponded to a "mental age" of fifteen years, six months, which is about average adult performance. In contrast, his performance on the abstract thinking test was very poor. Initially he had difficulty in grasping instructions. Having worked out the first and easiest problem, a simple arithmetic progression, correctly by himself, he applied the same principle (the principle of the first problem) to the remaining nineteen problems, giving evidence of a rigidity of set or "inability to shift attitude." The patient was told that his solutions of the remaining nineteen problems were incorrect and the second question was worked out in detail with him. Following this, he was able to solve only two of the remaining eighteen problems. It was evident that he was not capable of the type of abstract thinking demanded for the solution of these problems. His score corresponded to a "mental age" of nine years, ten months, C.Q. 63. Both the discrepancy between performance on this test and performance on the vocabulary test and the qualitative aspects of his behavior on the abstract thinking test definitely pointed to an impairment of "abstract behavior" in the patient.

### VII. SIMILARITIES TEST OF THE BELLEVUE SCALE (*32*)

Thirty-seven weeks after his accident, the patient was given the Similarities Test of the Bellevue Scale. In this test, which consists of 12 questions, the subject is asked in what way an orange and a banana, a coat and a

dress, a dog and a lion, etc., are alike. Answers are given two, one or no credits depending upon the quality of generalization made. Generally, two credits are given if the answers consist of showing the similarity by placing the items in a single class or category, *e.g.*, orange and banana—fruit; coat and dress—articles of clothing; dog and lion—animals, etc. On the other hand, only one credit is given generally if some concrete resemblance is mentioned, *e.g.*, orange and banana—both have peels; coat and dress—keep you warm; dog and lion—both have legs, etc. Our patient's performance on the test was quite poor, far below the average level. On no question was he able to make an answer which would give him a score of two, *i.e.*, he never answered a question by indicating that the two items belonged in a single class or category. Some of his answers may be quoted to show the limitations in his capacity to think in abstract terms and his tendency to think in the most concrete terms, *e.g.*, to be more impressed by differences than similarities.

(Orange and banana?) "Both got peels on it."

(Coat and dress?) "They're not alike. They both got fabric but they're not alike."

(Dog and lion?) "Both got fur."

(Wagon and bicycle?) "They're different. A wagon's got four wheels, a bicycle's got two." (But how alike?) "By having wheels."

(Air and water?) Patient could not answer this.

(Wood and alcohol?) "Alcohol is taken out of some wood."

The patient's performance clearly supported the impression that there is considerable weakness in thinking in abstract terms. This fact, considered in relation to the history of very successful business achievement and in relation to his performances on the vocabulary and information tests which indicated at least average *pre-traumatic* intelligence, was further evidence for the conclusion that he was suffering from a post-traumatic impairment of intellectual function.

## Discussions and Conclusions

The patient's performances on these tests may be briefly discussed with reference to the underlying intellectual defects which they brought to light.

First, an impairment in abstract thinking, in the ability to abstract, generalize and form concepts, which Goldstein (*14*, *15*) has emphasized as the fundamental defect in frontal lobe injuries, is clearly shown by performance on several tests (Weigl, Object-Sorting, Shipley, Similarities). The loss of the capacity to think in abstract terms has long been recognized as one of the salient features of cerebral defect. It is interesting to note that the tests employed brought out this defect clearly while the patient's general behavior was not informative about this point.

Secondly, an inability to handle spatial-objective problems, an incapacity to differentiate and manipulate a complex visual stimulus, is shown by performance on the Kohs test and the Rorschach. It would seem that, confronted by a complex visual stimulus, the patient receives only an undifferentiated "amorphous total impression," as in the case reported by Bouman and Grünbaum (*6*). This type of weakness in the differentiation and manipulation of spatial material has been frequently observed in cases of cerebral lesions.

Thirdly, a rigidity or fixity of set in combination with a poverty of associational activity is shown (Weigl, Object-Sorting, Rorschach, Shipley).

Re-examination after a short interval with certain of the tests (Rorschach, Kohs) indicated that no improvement

in condition had occurred during this interval.

The practical values of employing tests such as these in the evaluation of impairment of intellectual function are three-fold. First, basic weaknesses in intellectual functioning which may not be obvious from general behavior or from the observations made in the usual clinical examination may be revealed by the use of the tests. Secondly, a fairly accurate measure of the degree of impairment of function may be obtained. Finally, by repeating tests, the progress of a patient can be accurately checked.

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# CORTICAL ENERGY PRODUCTION IN THE PSYCHOSES*

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BY MEANS of electroencephalography it is now possible to record the energy output of the upper surface of the brain as measured in terms of electrical potential. This energy is manifested as waves of potential occurring at certain peak frequencies.

Alpha waves occur at the rate of from eight to twelve beats per second and attain a voltage of around fifty microvolts. They arise predominantly from the visual cortex with the eyes closed and the subject at rest. The amplitude and strength of the rhythm seems to depend on the number of neurons beating in synchronism. This in turn depends on the level of excitation of the cortex. Too great excitation, or too little, results in asynchronization and weakening of the alpha rhythm (*6*).

Beta waves are small waves beating at the rate of from about sixteen to forty beats per second and attaining a voltage of around five microvolts. Because the nature and origin of the beta waves are unknown, and their amplitude so small, they will be disregarded in this investigation.

Delta waves are large slow waves beating at a rate of from one-half to five per second. Their voltage varies from twenty to two or three hundred microvolts. Their origin is not known, except that they are the product of a physiologically or pathologically depressed cortex such as occurs during sleep, marked toxemia, mental deterioration, or in the neighborhood of a brain tumor.

Having such a method available, it was thought that a study of cortical energy production in the various psychoses might prove interesting.

## METHOD

The patients selected for this study presented fairly clear-cut diagnoses, were not taking drugs and were cooperative. A recording was made from each patient on at least three or more different occasions under the same conditions. This is especially important as it is well recognized that records from psychotic patients vary much more from time to time than those of normal control subjects. Only one or two recordings from a psychotic patient might be very misleading.

## RESULTS

### CONTROLS

Out of one hundred so-called normal controls, twenty-eight had a strong alpha rhythm, thirty-eight an alpha rhythm of medium strength, and thirty-four a weak alpha rhythm. Delta wave activity was practically absent from the records of these control subjects.

### TOXIC-ORGANIC REACTIONS (Fig. 1)

These cases include mental deficiency, post-traumatic reactions, encephalitis, drug and alcoholic psychoses, heredo-degenerative disorders, paresis, cerebral arteriosclerosis, senile and epileptic psychoses. There were

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fifty-six of these cases, with a strong alpha rhythm in only seven, an alpha rhythm of medium strength in eighteen and a weak alpha rhythm in thirty-one. Delta waves were present in the majority of these cases, especially those with marked changes in the sensorium. There did not appear to be any characteristic differences between the various reaction types, except that the mental defectives, paretics and seniles (Fig. 2) showed more alpha and less delta wave activity. Records obtained from epileptics during clinical or subclinical (larval) attacks showed a greatly increased output of potential in the form of characteristic epileptic waves described by Gibbs, Gibbs and Lennox (*2*).

SCHIZOPHRENIC REACTIONS (Fig. 3)

Out of the eighteen catatonic patients examined, four had a strong, two a medium, and twelve a weak alpha rhythm. Out of eleven hebephrenic patients, one had a strong, two a medium,

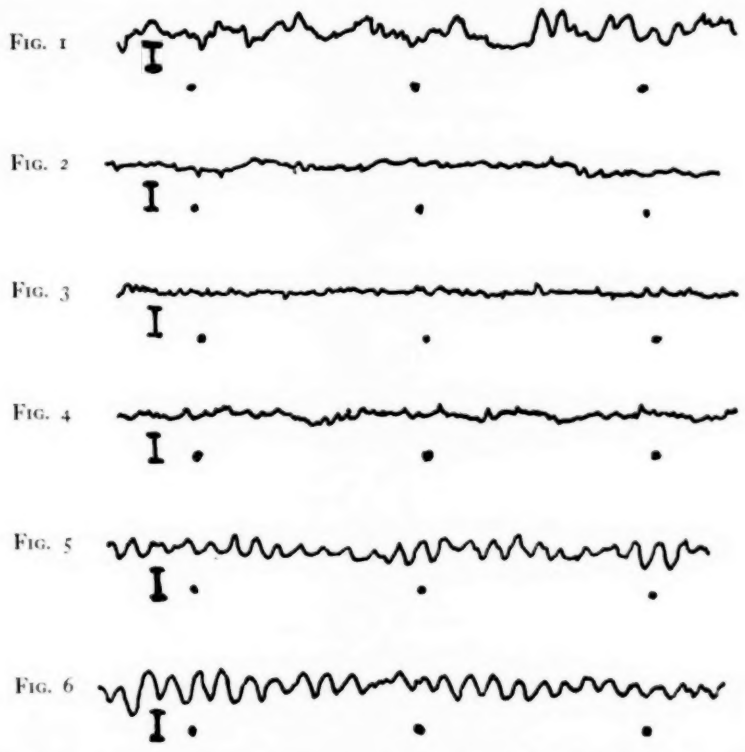


FIG. 1. Record from a patient with a post-traumatic psychosis. Shows pathological energy production in the form of slow 1–5/sec. delta waves seen with energy production in the form of 10/sec. alpha waves. In this and subsequent records, the dot time markers equal one second in time and the vertical scale at the side equals 50 millionths of a volt of potential. The records are read from left to right.

FIG. 2. Record from a patient with senile psychosis showing almost no energy production in the form of alpha waves but some abnormal delta wave production.

FIG. 3. Record from a patient in an acute attack of schizophrenia without deterioration. Almost no energy production in the form of either normal alpha waves or abnormal delta waves.

FIG. 4. Record from a chronic deteriorated schizophrenic patient. Almost no alpha wave energy production but some pathological delta wave energy production.

FIG. 5. Record from a depressed patient showing above average alpha wave energy production and a slight tendency toward delta wave production.

FIG. 6. Record from a manic patient also showing above average alpha wave energy production and a slight tendency toward delta wave production.

and eight a weak alpha rhythm. Out of twenty-one paranoid cases, five had a strong, six a medium, and ten a weak alpha rhythm. The delta wave activity was only moderately in evidence as compared with the toxic-organic cases. When present, it was mainly in the malignant or deteriorated type of case (Fig. 4).

agnoses. Gibbs, Gibbs and Lennox (*2*) believe that the electrical status of the cerebrum is probably more fundamental than clinical syndromes. As new insight is gained into the pathology of the psychoses, there undoubtedly will arise the need for reclassification (*13*).

Analysis of the results, however (Table 1), shows that in general the

TABLE 1

| Clinical Diagnosis | Number of Cases | Percentage of Cases Showing Noticeable Delta Wave Activity | Amount of Alpha Rhythm Strong % | Medium % | Weak % |
|---|---|---|---|---|---|
| 1. Controls | 100 | 2 | 28 | 38 | 34 |
| 2. Toxic-Organic Reactions | 56 | 41 | 12 | 32 | 56 |
| 3. Schizophrenic Reactions: | | | | | |
| Catatonic | 18 | 22 | 22 | 11 | 67 |
| Hebephrenic | 11 | 36 | 9 | 18 | 73 |
| Paranoid | 21 | 5 | 23 | 29 | 48 |
| 4. Manic-Depressive Reactions: | | | | | |
| Depressed | 19 | 16 | 53 | 11 | 36 |
| Manic | 12 | 25 | 42 | 25 | 33 |

*Table I.* Table showing relative amount of cortical energy production in the form of alpha and delta rhythm in the various reaction types as compared to that in one hundred normal controls.

MANIC-DEPRESSIVE REACTIONS (Figs. 5 and 6)

Out of nineteen depressed patients, ten had a strong, two a medium, and seven a weak alpha rhythm. Out of twelve manic patients, five had a strong, three a medium, and four a weak alpha rhythm. Delta wave activity was present only in the more disturbed or severely depressed patients.

## Discussion

The results, as presented, can only be interpreted as generalities. For more detailed study and accurate objective data some instrument such as the transform of the electroencephalogram described by Grass and Gibbs (*3*) would have to be used to measure the total potential output. Another difficulty interfering with any detailed analysis of these results is the discrepancy between the physiopathological and clinical di-

electrical energy produced by the cortex in the form of the alpha rhythm is low in the schizophrenic, senile, and the toxic-organic reactions as compared to the control subjects, while the manic-depressive reactions show a greater alpha energy production than the controls.

The delta wave energy production in this study represents pathologic cortical activity and seems to parallel fairly closely the temporary disturbance of the sensorium of the functional cases or the permanent deterioration of the chronic and organic cases.

The exact significance of these findings is obscure, but previous studies suggest that the low alpha rhythm in schizophrenia is due to a low activity cortex that permits irrelevant ideas to exist side by side without the energy necessary for proper segregation and rational correlation (*7*). I have previously postulated that this lack of cortical energy in schizophrenia is due pri-

marily to a constitutionally inadequate diencephalon (*8*). The basis for this belief is first the clinical aspects of the disease with inadequate, poorly sustained affect (thalamus) and defective, labile homeostasis (hypothalamus) usually associated with a normal or superior intelligence (cortex), at least in the earlier stages of the illness. Secondly, I have shown that agents that favorably influence the schizophrenic process, *e.g.*, insulin, metrazol and total push, also strengthen the alpha rhythm (*9*). These agents probably work primarily on the diencephalon as suggested by the work of Gellhorn (*1*), Massermann (*12*) and Grinker (*4*). At any rate, lesions of the diencephalon will depress the cortical energy production on the affected side (*10*), while electrical stimulation of the diencephalon strengthens the production of cortical energy (*5*). That a certain amount of energy is available to the schizophrenic is evident clinically from the episodic outbursts of affect and electrically by occasional bursts of alpha activity especially on the first tests. This activity does not seem to be able to be sustained, however, and this I believe is the basis of the schizophrenic process. Some of the initial manic-like excitements seen in schizophrenics may be an attempt at diencephalic compensation or the initial excitation that so often precedes neurologic suppression.

The overproduction of energy in the manic-depressive cases is considered as being the expression of the converse condition, *i.e.*, an overactive diencephalon with a secondarily overactive cortex. It is obvious clinically that the excess energy in this condition is primarily affective (diencephalic) with secondary intellectual distortions (cortical overexcitation). The observation that irritation of the diencephalon during surgery on this region produces manic outbursts substantiates this theory. That some manic-depressives have a low cortical energy output is thought to be due to cortical excitation above the point optimum to synchronized wave production. It is significant that as most of these patients quiet down the alpha waves become more prominent. I have suggested in another study that the mechanism of the convulsive treatment of manic-depressive cases may be a discharging of accumulated tension in much the same way a spark across the spark gap of an electric condenser discharges the accumulated electrical tension (*11*).

## Summary and Conclusions

1) Electrical cortical energy production, as determined by the strength of the alpha rhythm, is low in schizophrenic and toxic-organic psychoses. It is increased above the average for control subjects, in the affective reactions, including manic-depressive psychoses, and many paranoid states.

2) A theory is advanced on the basis of these and other findings suggesting that schizophrenia is due to a low energy cortex secondary to a primary diencephalic inadequacy. Manic-depressive reactions are considered to be the result of a high energy cortex secondary to a primary overactive diencephalon. The low energy cortex of the "organic" reactions is probably primary in the cortex itself.

3) Treatment efforts should probably be directed toward increasing the cortical energy output in schizophrenia and decreasing it in manic-depressive reactions.

4) Pathologic delta wave output parallels fairly closely the temporary disturbance of the sensorium of the functional cases or the permanent deterioration of the chronic and organic cases.

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PSYCHOSOMATIC MEDICINE—VOL. III, NO. 2, APRIL, 1941

# THE INCIDENCE OF NEUROSIS IN CASES OF BRONCHIAL ASTHMA

## AS DETERMINED BY THE RORSCHACH TEST AND PSYCHIATRIC EXAMINATION

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THE PROBLEM of the relationship between the asthmatic syndrome and the personality of the patient has been studied from two approaches: intensive psychoanalysis of a few individual patients and clinical interviews of groups of asthmatic patients. Interest has been centered around two points: the emotional precipitant of a single asthmatic attack and the total personality structure of the asthmatic patient.

C. H. Rogerson (*8*) studied thirty children who suffered from an asthma-prurigo syndrome. He found them to be over-active, restless, and excitable. They alternately displayed anxiety, timidity, fearfulness, insecurity, and irritability, aggression and domineering behavior.

H. F. Dunbar (*2*) concluded from the psychoanalysis of three asthmatics that they had certain personality problems in common. These were an intense reaction to separation from the mother, a demand for love which combined a fear of love and a revolt against it and in the case of the woman, a repudiation of the female rôle. They had homicidal trends associated with an impulse to self-injury. They tended to hold others responsible for their difficulties. The final interpretation was that these asthmatics were compulsive neurotics who developed few phobias or rituals except in periods free from asthma. Analytically, it might be said that they had weak ego organization with an inadequately assimilated superego.

A. M. Muhl (*6*) reports a cure by analysis of an asthmatic who had had the illness for thirty years. The psychodynamics of the syndrome in this individual were found to be those of a chronic anxiety based on financial strain. This had originally been a source of deep frustration to the patient. Repression of the consciousness of the frustration had resulted in anxiety which in turn had precipitated the asthmatic attack.

Another theory of asthma is that of Reichman who believes the predominating personality type to be manic-depressive. He conceives of bronchial asthma as a neurosis of the respiratory tract, a part manifestation of a general psychopathic conflict. He states that asthma is always accompaned by other psychopathic conditions, partly causal and partly secondary.

In 1922, N. Costa (*1*) said: "Asthma only becomes fixated through the neglect of the etiological factor (anxiety or other psychic attitude) followed by an irrational drug therapy."

C. Oberndorf (*7*) believes that the asthmatic attack represents the cry of an infant for the return of the mother. It is a manifestation of a conflict concerning emission and reception, domination and submission, unconscious masculinity, and conscious femininity.

In summary, it may be said that the general impression of those who have

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studied the relationship of personality and asthma is that emotional factors play a large part in the illness and that the individual attack represents the mode of reaction of the patient to an inner conflict.

This study was undertaken with the purpose of discovering whether such a reaction to inner conflict was uniformly associated with any particular personality type.

## Method

Rorschach records of forty patients with bronchial asthma were obtained, scored individually, then compared with each other and with two control groups of normal persons collected by Harrower-Erickson (*4*) and G. E. Gardner (*3*).

## Material

Thirty-nine patients being treated for bronchial asthma in the Allergy Clinic of the Mount Sinai Hospital in New York City and one asthmatic boy referred from an outside source (Pleasantville) were given Rorschach Tests. The first four patients attending each successive clinic session were chosen for the study thus insuring a random sample. The ages varied from 14 to 76 years with an average of 36.7 and a median age of 35 years. There were 32 females and 8 males. The clinical diagnosis of asthma was further subdivided by the allergists into extrinsic (allergen outside the body, such as food, dust, etc.) and mixed. The distribution of our sample was extrinsic 16, intrinsic 13, and mixed 9. There were in addition two cases which could not be classified by the allergists.

## Results

1. Incidence of psychoneurosis among the asthmatic patients in this series was determined by the use of Miale's signs (*5*). These are:

1. Number of responses to the ten cards not over 25.
2. Number of human movement responses not over one.
3. Animal movement responses must occur more frequently than human movement.
4. Color shock.
5. Shading shock.
6. Complete refusal to respond to one or more cards.
7. Rigidity as evidenced by more than 50 per cent responses determined by pure form.
8. Mental stereotypy as evidenced by more than 50 per cent animal responses.
9. Emotional adjustment as evidenced by form-color responses is inadequate in that FC is less than one response determinant.

Table I gives the distribution of these signs in the Rorschach record of each individual of the series. According to Miale's report, five or more of the signs must be present in an individual's Rorschach record if the diagnosis of psychoneurosis is to be made with any degree of accuracy.

In the 40 cases in our series, 25 or 62.5 per cent presented 5 or more of these signs. There was no significant difference between the extrinsic and the intrinsic asthmatic groups so far as incidence of psychoneurosis was concerned. Correlation of these findings with the results of clinical interviews by the author and others showed the following:

a) All the patients found to be neurotic by the Rorschach technique gave the same impression clinically. A representative case follows:

1. E.S., a 40-year-old Jewish housewife who had suffered from a large variety of somatic symptoms for the past 10 years. The first complaints were of vomiting, eructations, constipation, and dizziness. After a thorough physical work-up including gastric analysis and X-rays, a diagnosis of gastric neurosis was made. Four years later,

TABLE I

DISTRIBUTION OF MIALE'S SIGNS IN FORTY ASTHMATIC RORSCHACH RECORDS

| Subject | Age | R | M | FM>M | Color Shock | Shading Shock | Refusals | F%>50 | A%>50 | FC<1 | Signs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TA | 44 | x | | | | | | | | x | 2 |
| RA | 26 | x | x | x | x | | | x | | x | **6** |
| JB | 34 | x | | x | x | x | | | | x | **5** |
| TB | 49 | x | x | x | | | x | x | | x | **6** |
| MB | 48 | x | x | x | | | | x | x | x | **6** |
| SC | 32 | x | x | x | | | | | | x | 4 |
| GC | 24 | x | x | x | | | | x | | x | **5** |
| JM | 25 | x | x | x | | x | x | x | x | x | **8** |
| FD | 47 | x | | | x | | | x | | x | 4 |
| DF | 76 | x | x | | x | x | | x | | x | **6** |
| FF | 36 | x | | x | x | x | | x | x | x | **7** |
| RG | 41 | x | x | x | x | x | x | x | x | | **8** |
| SG | 64 | x | | | x | | | x | x | | 4 |
| BH | 25 | x | x | x | x | x | | x | | x | **7** |
| SH | | x | x | x | x | x | | x | x | x | **8** |
| LH | 34 | x | x | x | x | x | | | | x | **6** |
| LK | 31 | x | | | | | | | | x | 2 |
| RK | 21 | x | | x | | | | | | x | 3 |
| RKs | 34 | x | x | x | | x | | x | x | x | **7** |
| JM | 53 | x | | | | | | x | | x | 3 |
| JL | 41 | x | x | x | x | x | | x | x | x | **8** |
| LM | 35 | x | | | | | | | | x | 2 |
| EM | 19 | x | x | x | x | x | x | x | x | x | **9** |
| RM | 54 | | | x | | | | | | | 1 |
| EN | 41 | x | x | x | | | | x | | | 4 |
| WR | 35 | x | x | x | | x | | x | x | x | **7** |
| RR | 33 | x | x | x | | x | | x | x | x | **7** |
| AR | 41 | x | | | x | x | x | x | | x | **6** |
| GR | 29 | x | | | x | | | x | | x | 4 |
| GrR | 35 | x | | | x | x | | x | x | x | **6** |
| GRo | 40 | | | | | x | | | | | 1 |
| BS | 33 | x | x | x | x | x | | x | | x | **7** |
| MS | 38 | x | x | x | | | | | x | x | **5** |
| SS | 50 | x | x | x | | | | x | x | x | **6** |
| PS | 44 | x | x | x | | | | x | | | 4 |
| ES | 40 | x | | | | x | x | | | x | 4 |
| HS | 31 | | x | | | | | | | x | 2 |
| EdS | 14 | x | x | x | x | | | | x | x | **6** |
| SS | 26 | | | x | x | x | | x | | x | **5** |
| BZ | 30 | x | x | x | x | x | x | | x | x | **8** |

Boldface figures in the final column represent records of neurotic patients.

she became very depressed following the death of a sister to whom she had been much attached. She had frequent crying spells, complained of constant dizziness and fainted several times. While she was convalescing, she had her first attack of asthma. A psychiatrist at that time elicited the information that her husband had been impotent for several months following an episode in which he believed the patient to have been unfaithful to him. Since then, the patient has concentrated all her efforts on her son. She alternately overprotects him and forces him to take care of her. The asthmatic attacks are mild and infrequent but a constantly changing variety of somatic complaints continues.

Psychiatric diagnosis by Dr. M. Kanzer —conversion hysteria.

b) Of those not considered neurotic by the Rorschach technique:

2. H.S. is a 31-year-old single, white stenographer who has suffered from severe asthmatic attacks since she had bronchopneumonia 14 years ago. A thyroidectomy was done 8 years ago for tremor, exophthalmos, nervousness, loss of weight, sweating, and amenorrhea with marked improvement in these symptoms. Her father died in status asthmaticus and since then her mother has been paranoid. A sister has been suffering from schizophrenia, hebephrenic type and has been in a State Hos-

pital for 5 years. The patient is evasive, anxious and negativistic. She tries to protect her mother from the doctors who are urging institutionalization and at the same time consciously precipitates her mother's asocial behavior. H.S. attends the Psychiatric Clinic irregularly and has been tentatively diagnosed as early schizophrenia.

3. G.R. is a 40-year-old beautician who complains of wheezing and cough of one year's duration, vertigo, and occasional orthopnea for 1–3 months, hay-fever for 10 years and urticaria since early childhood. Recent biopsy of the conjunctiva revealed evidence of periarteritis nodosa. One son has hay-fever and one has asthma. Her first husband died 15 years ago of angina pectoris and her present husband suffers from the same disease. The patient is highly intelligent, rather masculine in appearance and attitude and shows marked hostility to her husband and children. In view of the diffuse vascular disease and the transient neurological signs usually following an attack of asthma, no definite psychiatric diagnosis has been established but "organic psychosis" has been considered most probable.

4. E.N., S.C., F.D. and S.G. have intellectual defects (I.Q. less than 70) which make a comparison of their records with those of the rest of the series inaccurate in certain respects.

5. L.K., R.M. and G.R. appear to be emotionally stable.

6. L.M. is a 35-year-old attorney who developed an asthmatic cough 4 weeks ago. He had hip disease 30 years ago and although he had been in a cast for 2 years, he still has a residual limp. He has never been able to exercise much because of this and is markedly obese. Until two months ago, he had worked as a law clerk and had not been forced to appear in court but when the occasion arose, he became very self-conscious and felt he could not appear before an audience limping and looking so obese. Shortly thereafter, he developed a cough and has not worked since. While looking at the Rorschach cards, he volunteered the information that the doctors were trying to cure the asthma which hardly bothered him but that no one had told him how he was going to live if he could not practice law because of his self-consciousness.

7. R.K. is a 20-year-old white boy with an effeminate appearance and gait, and a husky voice. Two months ago, he had a severe cold and since then has had a wheezing cough. Attacks of wheezing occur 2–3 times a day and are only relieved by hypodermic adrenalin. There is no familial history of allergies. Except for diplopia of one month's duration after he was hit on the head by a baseball, three years ago, there is no evidence of past illnesses of any significance. He was a behavior problem in school and ran away from home several times in early adolescence. His parents complain that he is slovenly and lazy, refuses to get out of bed, insists on being waited on and is impudent. He works on and off but leaves his jobs when he gets tired of them although the family is in very poor circumstances and needs his help.

8. J.M. and P.S. are obsessive neurotics. Because of language difficulties, a detailed psychiatric examination was not done. J.M. has a cat phobia and collects drugs which she never takes but which she must look at periodically. P.S. has a dressing ritual which causes her family great concern.

In summary, it may be stated that after eliminating mental defectives and those with cerebral disease, only three of the entire group of patients remain who might be called clinically free from neurosis or neurotic character traits by psychiatric tests.

2. The basic personality configurations are shown in Table II.

3. The mode of control is shown in Table III.

4. Approach is shown in Table IV.

## Discussion

Analysis of the composite Rorschach psychograms of 40 asthmatic patients (Table V) is justifiable only with the warning that the personality structure

TABLE II

ERLEBNISTYP OF FORTY ASTHMATIC RORSCHACH RECORDS

| Subj. | M | FM+m | Sum C | Fc+c+C′ | %R in Last 3 Cards |
|---|---|---|---|---|---|
| TA | 4 | 2 | 0.5 | 1 | 33 |
| RA | 0 | 2 | 1.5 | 2 | 22 |
| JB | 3 | 5 | 0.5 | 0 | 33 |
| TB | 0 | 0 | 1.5 | 0 | 33 |
| MB | 1 | 8 | 1.5 | 2 | 33 |
| SC | 0 | 3 | 3.0 | 3 | 25 |
| GC | 0 | 2 | 0.5 | 1 | 28 |
| JM | 1 | 2 | 0.0 | 1 | 30 |
| FD | 2 | 1 | 0.0 | 2 | 25 |
| DF | 1 | 1 | 4.0 | 1 | 35 |
| FF | 2 | 5 | 0.0 | 1 | 33 |
| RG | 0 | 2 | 1.0 | 0 | 50 |
| SG | 2 | 0 | 1.5 | 0 | 50 |
| BH | 0 | 1 | 3.5 | 0 | 46 |
| SH | 1 | 3 | 2.0 | 0 | 60 |
| LH | 0 | 3 | 1.0 | 3 | 36 |
| LK | 5 | 1 | 0.5 | 1 | 43 |
| RK | 3 | 6 | 3.5 | 1 | 41 |
| RKs | 0 | 3 | 0.0 | 0 | 40 |
| JM | 3 | 2 | 0.5 | 0 | 42 |
| JL | 1 | 4 | 0.0 | 0 | 33 |
| LM | 4 | 1 | 3.5 | 2 | 29 |
| EM | 0 | 3 | 0.0 | 0 | 54 |
| RM | 2 | 6 | 3.5 | 6 | 28 |
| EN | 0 | 2 | 4.0 | 1 | 33 |
| WR | 2 | 1 | 1.0 | 3 | 50 |
| RR | 2 | 2 | 1.0 | 1 | 45 |
| AR | 4 | 1 | 14.0 | 6 | 38 |
| GR | 0 | 2 | 0.0 | 2 | 21 |
| GrR | 0 | 1 | 0.5 | 0 | 30 |
| GRo | 2 | 1 | 1.5 | 0 | 44 |
| BS | 1 | 3 | 1.5 | 0 | 32 |
| MS | 0 | 2 | 0.5 | 2 | 30 |
| SS | 0 | 2 | 0.0 | 1 | 28 |
| PS | 0 | 0 | 2.0 | 1 | 35 |
| ES | 2 | 1 | 0.0 | 2 | 27 |
| HS | 3 | 2 | 0.0 | 6 | 30 |
| FdS | 0 | 5 | 4.0 | 1 | 43 |
| SS | 2 | 4 | 2.0 | 2 | 33 |
| BZ | 1 | 3 | 0.0 | 4 | 33 |
| Ave. | 1.7 | 2.9 | 1.6 | 1.5 | 34.25 |
| Med. | 1.0 | 1.5 | 1.0 | 1.0 | 36 |
| S.D. | 1.346 | 1.150 | 2.438 | 1.560 | 1.200 |

EXPLANATION OF TABLE II

Erlebnistyp is the word used by Rorschach to classify a personality as introverted, extroverted or ambiequal. It has been found empirically that there are three proportions available in every Rorschach record which give the Erlebnistyp. If all three agree, the validity of the conclusion is high. These quotients are M; sum C; FM M:Fc c C; proportion of responses to cards 8, 9, 10.

The average and median figures in Table II represent each of the proportions necessary for determination of Erlebnistyp and, if compared with the standard figures for normal persons of each personality type, will be found to conform most closely to the category of ambiequal.

In the ratio of FM m:M the animal and expression responses outweigh the human movement responses which can be interpreted as a tendency on the part of these patients to allow freer play to their primitive drives than to their integrated, creative activity.

TABLE III

INDEX OF CONSTRICTION OF FORTY ASTHMATIC PATIENTS

| Subj. | No. of F | R | %F | $\frac{\%FK+F+Fc'}{R}$ |
|---|---|---|---|---|
| TA | 5 | 12 | 42 | 50 |
| RA | 6 | 11 | 55 | 73 |
| JB | 4 | 13 | 33 | 33 |
| TB | 7 | 9 | 78 | 78 |
| MB | 3 | 12 | 25 | 50 |
| SC | 6 | 11 | 54 | 54 |
| GC | 6 | 10 | 60 | 70 |
| JM | 11 | 16 | 69 | 69 |
| FD | 8 | 14 | 56 | 64 |
| DF | 7 | 15 | 47 | 47 |
| FF | 9 | 13 | 69 | 69 |
| RG | 13 | 18 | 67 | 67 |
| SG | 7 | 13 | 53 | 53 |
| BH | 4 | 11 | 36 | 63 |
| SH | 9 | 15 | 60 | 60 |
| LH | 6 | 17 | 35 | 48 |
| LK | 10 | 13 | 77 | 77 |
| RK | 9 | 14 | 64 | 70 |
| RKs | 8 | 10 | 80 | 80 |
| JM | 9 | 16 | 56 | 63 |
| JL | 13 | 24 | 54 | 54 |
| LM | 17 | 36 | 47 | 66 |
| EM | 13 | 21 | 62 | 67 |
| RM | 17 | 20 | 85 | 85 |
| EN | 8 | 22 | 33 | 45 |
| WR | 13 | 23 | 57 | 57 |
| RR | 12 | 23 | 49 | 49 |
| AR | 9 | 24 | 38 | 50 |
| GR | 17 | 30 | 54 | 60 |
| GrR | 10 | 23 | 44 | 70 |
| GRo | 15 | 23 | 65 | 65 |
| BS | 8 | 34 | 23 | 32 |
| MS | 10 | 18 | 56 | 72 |
| SS | 9 | 18 | 50 | 62 |
| PS | 6 | 13 | 46 | 46 |
| ES | 11 | 15 | 73 | 80 |
| HS | 10 | 14 | 73 | 75 |
| FdS | 5 | 11 | 45 | 64 |
| SS | 3 | 14 | 21 | 21 |
| BZ | 4 | 12 | 33 | 58 |
| Average | | | 50.9 | 64.5 |
| Median | | | 54 | 60 |
| Standard Deviation | | | 2.66 | 1.13 |

The F column represents controlled intellectual responses and should not constitute more than 50 per cent of the total number of responses. $\frac{\%F+Fc+C'}{R}$ should not constitute more than 75 per cent of total responses. This table shows these columns to be developed to the upper limit of the normal and can be interpreted as evidence of a rigid personality.

The closer conformity between the sum c and Fc+c+C′ responses can be interpreted as a relatively mature adjustment to environmental stimuli. However, the large number of cases in which there is no response to any of the colored cards leads one to suspect that these patients avoid the environment whenever possible in spite of their ability to cope with it when necessary.

TABLE IV

MODE OF APPROACH OF FORTY ASTHMATIC PATIENTS

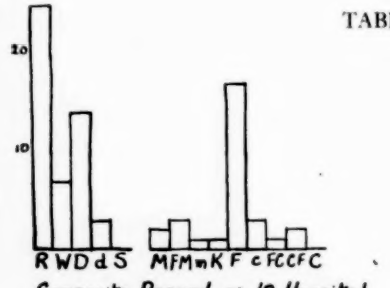
| *W* | | *D* | | *d* | | *Dd+S* | |
|---|---|---|---|---|---|---|---|
| 10% | 0 | 30% | 2 | 10% | 36 | 10% | **36** |
| 10–20 | 4 | 30–45 | 10 | 10–20 | **4** | 10–15 | 3 |
| 20–30 | **5** | 45–55 | **11** | 20–30 | 0 | 15–20 | 0 |
| 30–45 | 10 | 55–65 | 11 | 30–40 | 0 | 20–25 | 1 |
| 45–60 | 14 | 65–80 | 5 | 40–50 | 0 | 25–30 | 0 |
| 60 | 5 | 80 | 1 | 50 | 0 | 30 | 0 |

The categories which are *underlined* are those in which the greatest number of responses would fall in a normal record. In the case of these asthmatic patients, the increase in *W* responses may be interpreted as a tendency toward a predominantly abstract mental approach. The rather low number of *d* responses most likely represents an inability to perceive more than the most superficial and obvious in a given situation.

derived by this method be confirmed by clinical observation on a much larger series. The only Rorschach factors which are being used for such an interpretation are those which have a high statistical validity in our own series. In spite of this mathematical validity, the results are subject to the misinterpretation of all such projects in that any random patient may fall in the minority percentile of the series and thus not conform to the personality of the majority of the patients in the group. However, a further reason for venturing such an interpretation in spite of the limited number of cases on which it is based, is that the results are confirmed by the clinical literature.

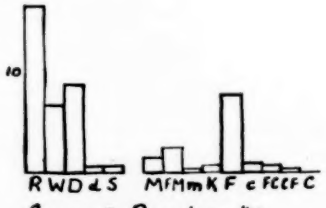
The interpretation of the composite Rorschach record of our series shows the asthmatic patient to be a sufferer from a psychoneurosis of an obsessive type. He tends to react to his problems, both environmental and personal, in a theoretical and detached manner, frequently jumping to conclusions or interpreting something on its face value rather than breaking it down into its component parts. He tends to be rigid in his reactions and covers his emotional turmoil by excessive intellectualization. Whenever possible, he takes refuge from a hostile environment by

TABLE V

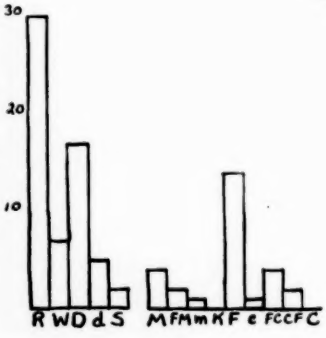



Composite Record of 10 Hospital Employees

Harrower-Erickson - Arch. Neurol. Psychiat. 43: 868, 1940.




Composite Record of 40 Patients with Bronchial Asthma




Record of Hypothetic Normal Person

Arch. Neurol. Psychiat. 43: 865, 1940.

engaging in a fantasy life, but when forced to face an environmental problem, does so with greater maturity than his infantile manner of handling his inner life would have led one to suspect. He has an anxious, cautious and unfree kind of affective adaptability, and especially an inclination toward a depressive trend which he tries to master in the presence of others. There is a moderate degree of anxiety which is repressed by the fairly rigid intellectual control. Analysis of the content of the responses does not reveal any evidence of specific phobias or compulsions.

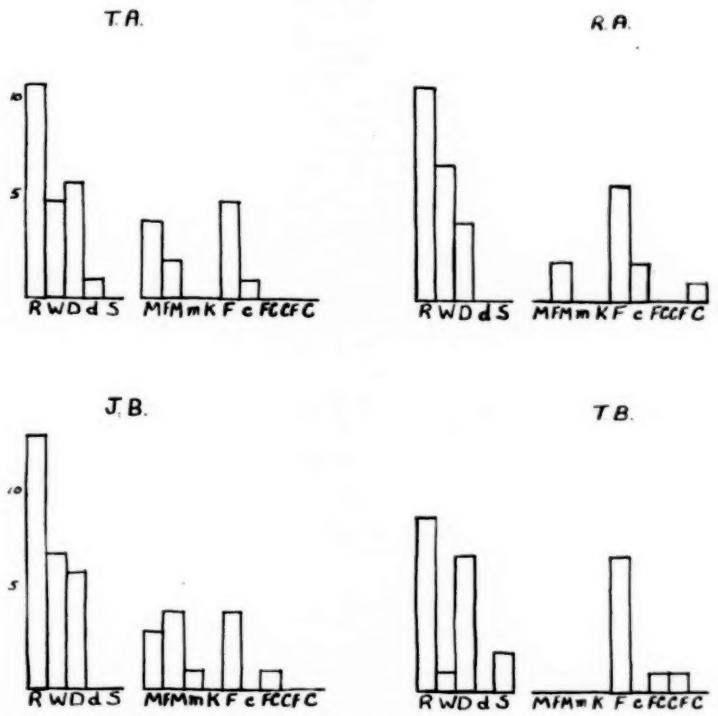
## Conclusion and Summary

Analysis of the Rorschach Records of forty patients suffering from bronchial asthma confirms the impression based on psychoanalytic methods that asthmatics tend to have compulsive personalities without evidence of phobias or compulsions.

## Method of Presentation of Results

The subject's responses to the ten standard ink-blots have been summarized in graphic form in Tables V to XV.

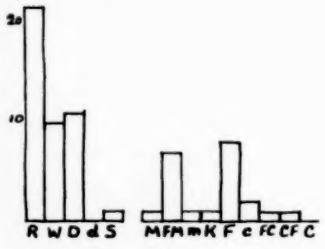
TABLE VI



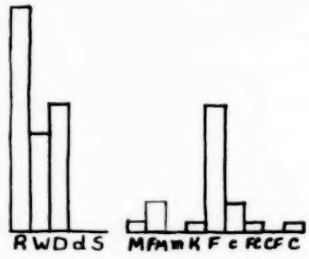

These graphs or psychograms represent the output, mental approach and depth of psychic experience but do not take into account many other interesting and valuable results of the Rorschach record. Tables I to IV consist in a statistical summary of some of the salient results which can not be represented in the psychogram. Both the graphic and the numerical results have been found to have a high statistical validity and can, therefore, be accurately compared with the hypothetical normal Rorschach records obtained by Harrower-Erickson.

TABLE VII

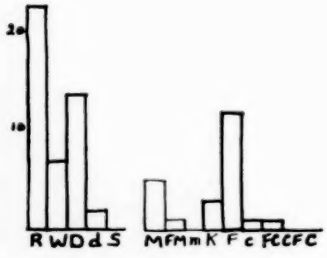
M.B.




S.H.




L.K.




R.K.

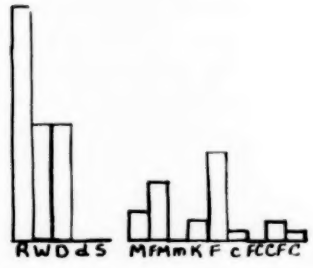
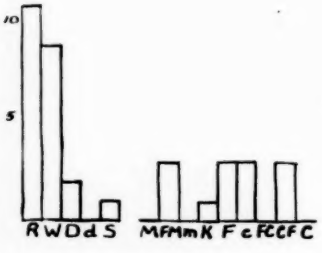
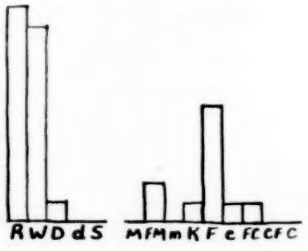



TABLE VIII

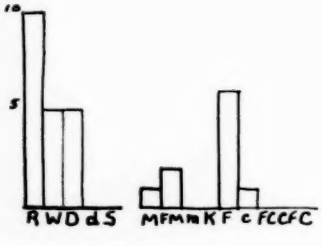
S.C.




G.C.




J.D.




F.D.

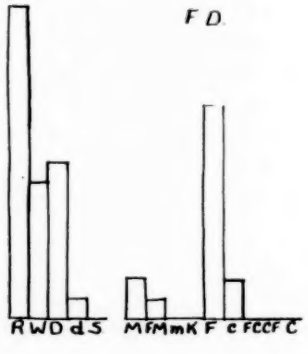


TABLE IX

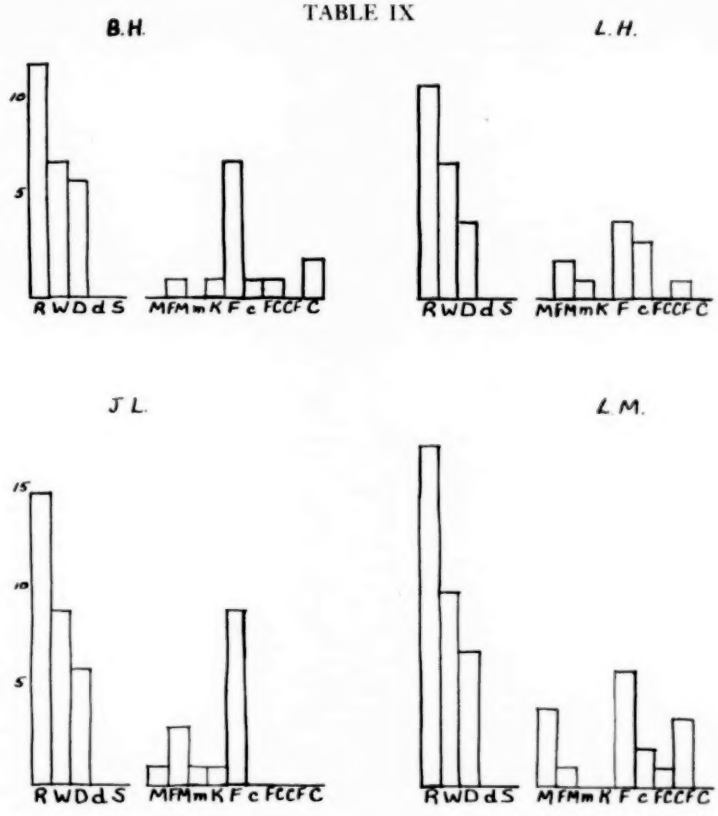



TABLE X

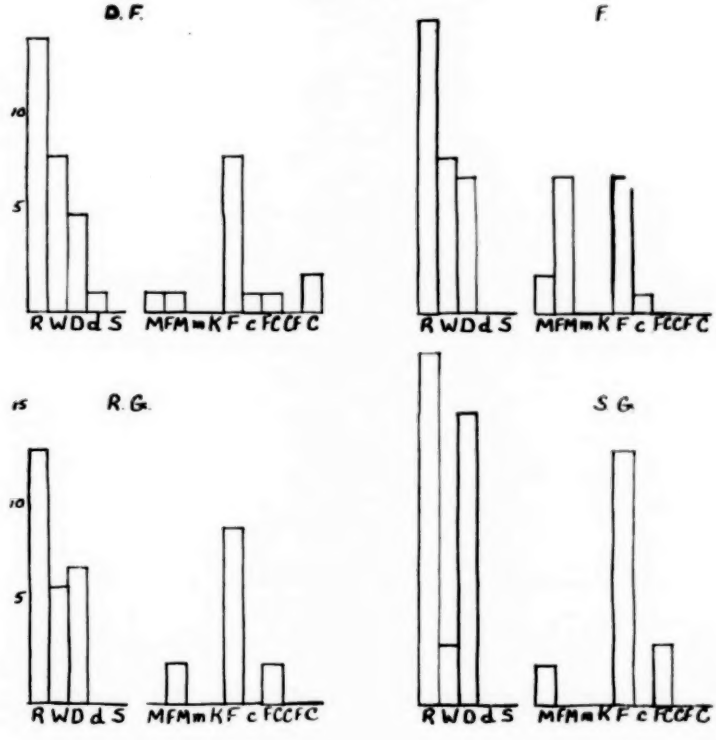


TABLE XI

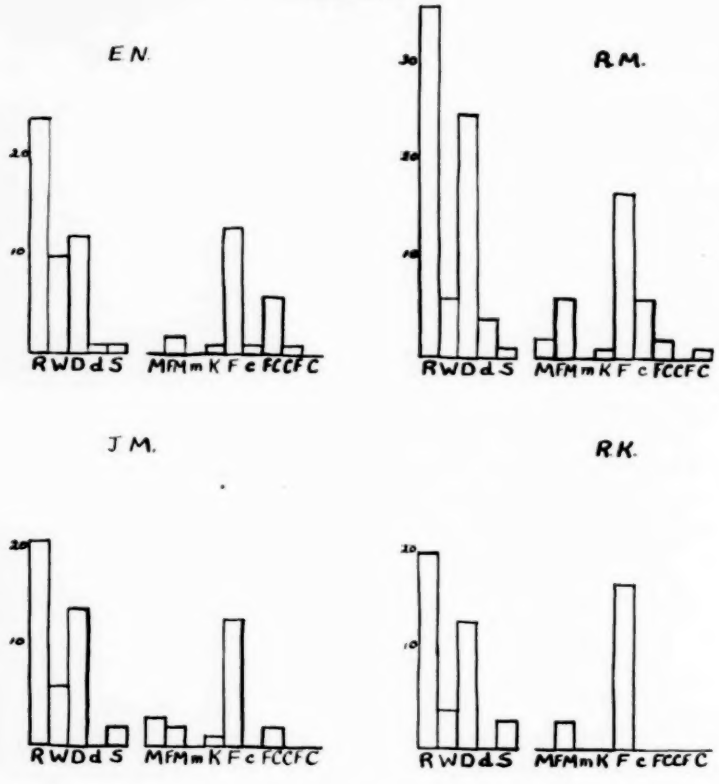



TABLE XII

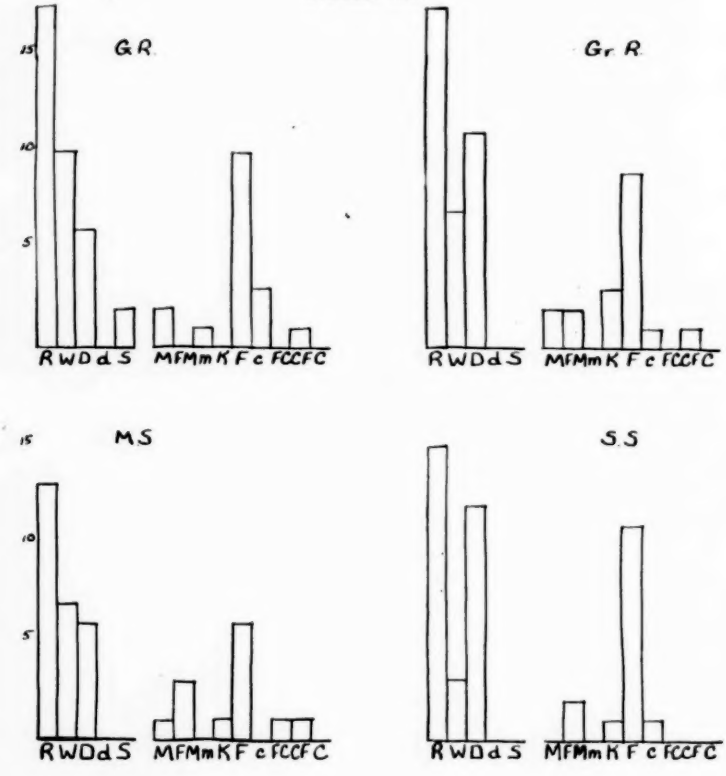


TABLE XIII

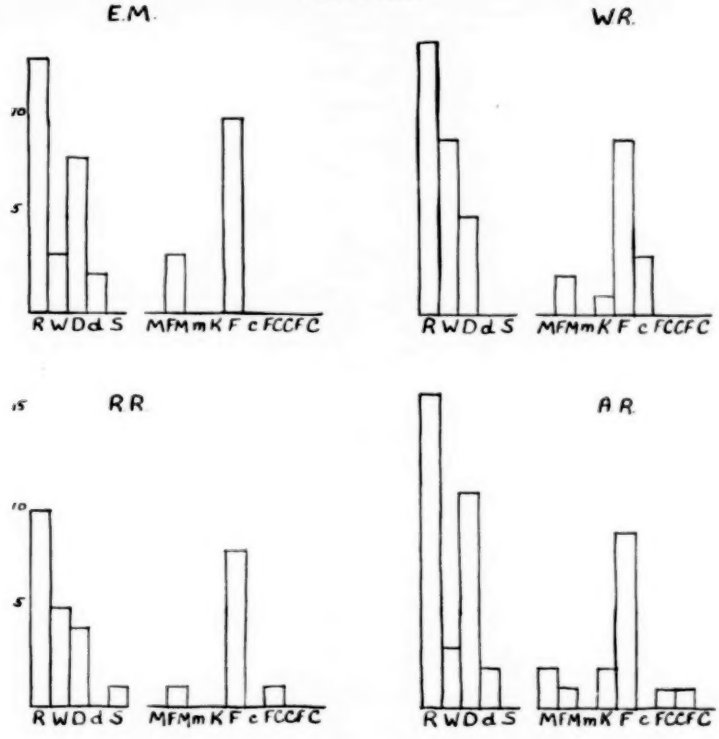



TABLE XIV

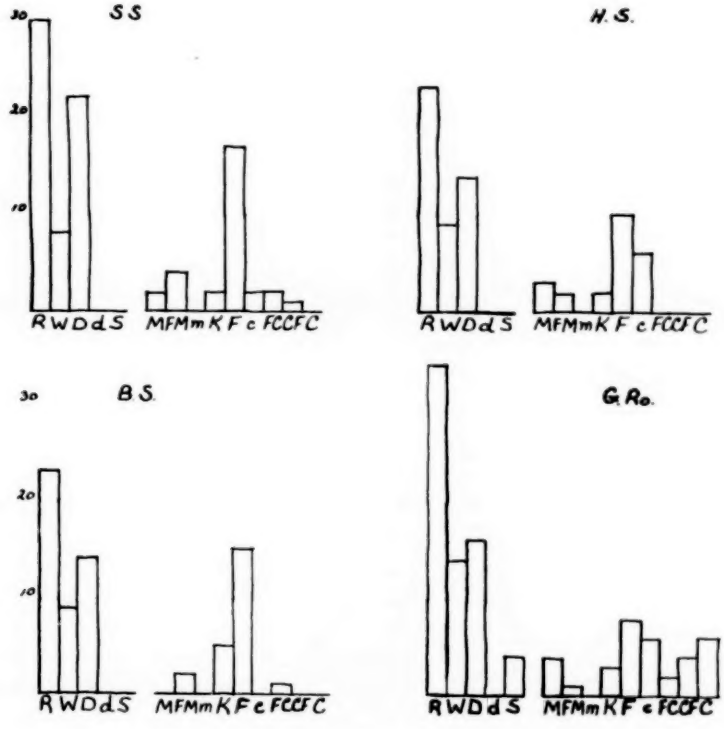
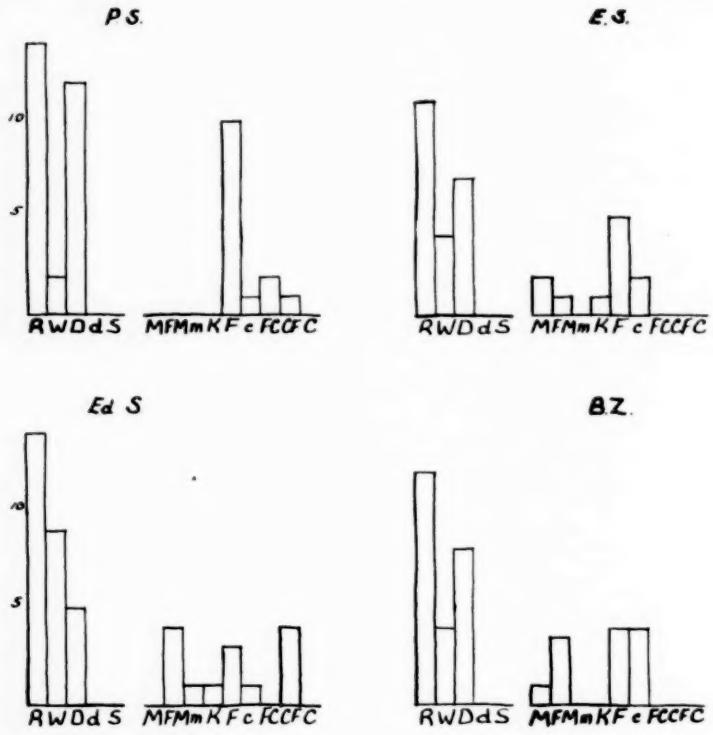


TABLE XV




Explanation of lettering used in all tables:

1. W stands for the number of responses in which the whole blot was used for interpretation.
2. R is the total number of responses given in one Rorschach test.
3. D stands for the number of responses in which a large detail of the blot was used for interpretation. Example: the pink figures in card 8 are called animals.
4. d stands for small detail as when the lateral projections in card 6 are called whiskers but no mention is made of the head on which the whiskers are placed.
5. S stands for white space as for example the white part of card 2 being called a fan.
6. M stands for human movement such as two clowns clapping hands in card 2.
7. FM stands for animal movement as two bears climbing a mountain in card 8.
8. m stands for movement of inanimate objects or expression as two women sulking in card 7.
9. K stands for use of shading as diffusion such as clouds or smoke.
10. F represents the number of responses in which form alone was used for interpretation as a bat for card 5.
11. c stands for the use of shading as texture as a fur rug for card 6.
12. FC stands for the fusion of form and bright color when both determinants are indispensable.
13. CF is represented in those responses where color determines

the response and form is subsidiary.

14. C is shown in those responses which are determined by color alone.
15. Color shock means that there was evidence of disturbance in reaction to the cards which contain bright color—which represents emotional stimulation from the environment. This shock may take the form of significant delay in time prior to the first response to the card or comments or exclamations by the subject indicative of emotions not aroused by the uncolored cards, or rejection of the card.
16. Shading shock represents a similar reaction to the two strongly shaded cards and is evidence of anxiety.
17. Refusal means rejection of the card even after urging.
18. A% over 50 is an index of stereotypy.

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# VASO-DILATATION IN NORMAL AND SCHIZOPHRENIC SUBJECTS DURING CYCLOPROPANE ANESTHESIA*

H. FREEMAN, M.D **

PHYSIOLOGIC INVESTIGATIONS of schizophrenic patients have disclosed a diminution of reactivity of the autonomic nervous system (*4*) and a lessened integrative capacity of the organism in various functions (*1*). Local abnormalities of cerebral tissue have been demonstrated by pneumoencephalograms (*6*) and by electroencephalograms (*7*).

The bilateral rise of skin temperature under general anesthesia has been considered as a possible method of investigation of both autonomic reactivity and of bilateral integration. The variation produced by vasomotor paralysis gives some indication (organic changes in the blood vessels being excluded) of the vaso-dilating capacity of the organism, and the degree of symmetry of such change on the extremities throws some light on the bilateral nature of the reaction.

The present investigation deals with the change in the surface temperature of the feet under cyclopropane[1] anesthesia. The study was made in a psychometric room where the environmental conditions were maintained so that the pre-anesthetic skin temperatures would be low, thus allowing for greater range of variation. The average room temperature was 18° C. and the average relative humidity was 30 per cent.

The subjects, in a fasting state, reclined on a bed with the lower extremities exposed from the knees down. After approximately 30 minutes, a subcutaneous injection of 0.6 mgm. of atropin sulphate was administered. Immediately thereafter and every two minutes subsequently, measurements were made, by means of the Hardy radiometer (*5*), of the temperature of the dorso-lateral surface of each foot beneath the external malleolus. The temperature of one foot was measured immediately after that of the other. In successive determinations the order of precedence in the measurement of a given foot was intentionally varied so as not to lend any temporal bias to the temperature readings of a given extremity.

As a control measure, ten sets of readings were taken on the feet over a period of twenty minutes. The subjects then inhaled a cyclopropane-oxygen mixture until thorough relaxation had been obtained and the temperature level had risen markedly. Throughout the anesthetic period the determinations were continued at the same interval. The average duration of anesthesia was 29 minutes, varying from a minimum of 22 to a maximum of 42 minutes in the normal subjects, and 28 minutes, varying from 12 to 38 minutes in the patients.

The studies were made on 10 normal subjects (6 male and 4 female) and on an equal number of physically healthy male schizophrenic patients. The con-

* This investigation was aided by a grant from the Rockefeller Foundation.

** From the Research Service of the Worcester State Hospital, Worcester, Massachusetts.

[1] The cyclopropane was contributed by E. R. Squibb & Sons.

trol subjects were all employees of the hospital. The age variation in both groups ran from 20 to 40 years, the average age of the normal subjects being 28, and of the patients, 30. The average duration of hospitalization of the patients was 7 years, only three having been confined to the institution less than 1 year. The patients were selected at random and represented subtypes of the psychoses, six being catatonic, two simple, one paranoid, and one hebephrenic.

Fig. 1 shows the mean of the skin temperatures of the feet for the group of 10 normal subjects and 10 schizophrenic patients during the control period and under anesthesia. As the group trends in both feet were quite similar, the average for the readings of the two lower extremities has been taken. During the control period there was a slight but steady fall in the temperature of the feet owing to the transfer of heat from the skin to the colder air in the room. After eight minutes of anesthesia this trend was reversed and a rapid rise in temperature ensued. The rapidity of this elevation is in contrast to the slowness of the previous fall and is suggestive of a sudden release of vasoconstricting elements. At a skin temperature of 29° C. the curve begins to level off despite the maintenance of anesthesia.

Two facts may be noted from this chart. The temperature of the patients' feet is continuously higher than that of the normal subjects. This finding confirms the results of a previous investigation that schizophrenic patients, placed in the same environmental conditions as normal subjects, do not, as is commonly believed, have colder extremities than non-psychotic individuals (*2*). Second, and this is more important, the trends of temperature for the two types of subjects are quite parallel. This would indicate that the mechanisms involved in vaso-dilatation are as functionally adequate in the schizophrenic patient as in the normal subject, and that from this point of view the autonomic mechanisms are not disturbed.

Despite the fact that a rise in temperature is found in both feet, the trends are not exactly parallel. The usual finding is a marked diversity of trend during the period of sharp rise of temperature, which, however, at the higher levels tends to lessen so that the

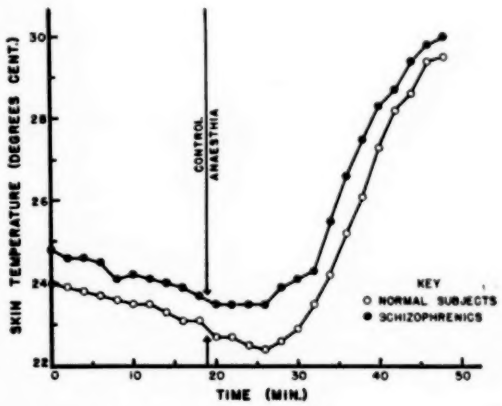


FIG. 1. Average foot temperatures of ten normal subjects and ten schizophrenic patients measured every two minutes before and during cyclopropane anesthesia.

values for the two extremities become quite similar. The varying types of reaction are shown in Fig. 2. These graphs depict the relationship of the temperature of one foot with that of the other. The crosses indicate the pre-anesthetic or control values. The dots show the measurements obtained under anesthesia. The perfect correlation line is drawn to illustrate more clearly the divergences. In graph 2A the control figures for the two feet are practically identical and remain so throughout the anesthesia, indicating an identical rise in the temperature of both feet. In 2B the control values for the two feet are identical but during anesthesia the left foot rises more rapidly than the right, approaching it, however, at the highest

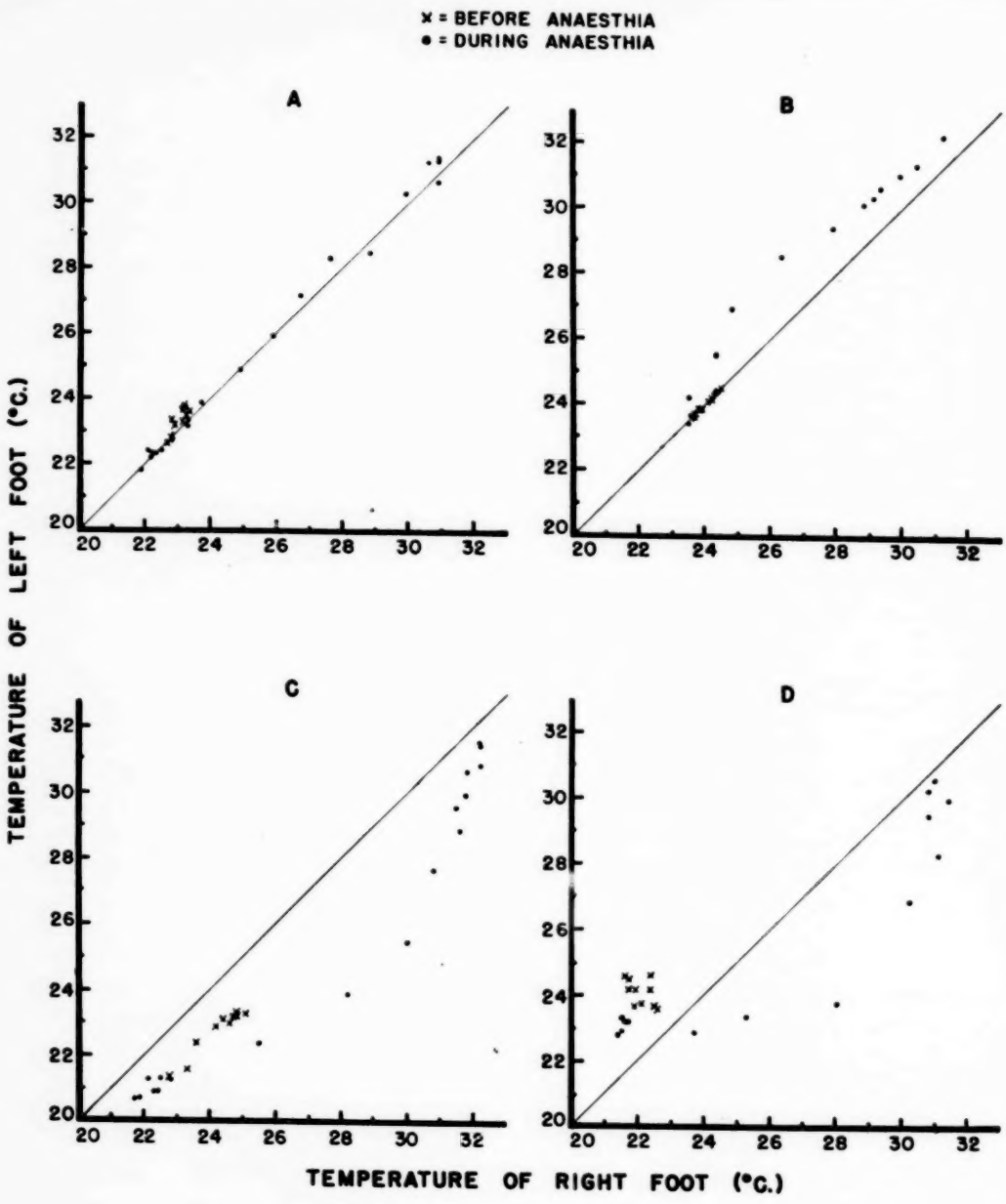


FIG. 2. Typical relationships between left and right foot temperatures before and during cyclopropane anesthesia.

levels. In Fig. 2C the right foot in the control period is warmer and also shows more rapid vaso-dilatation under anesthesia. In Fig. 2D the left foot has the initially higher temperature but during anesthesia the right foot rises in temperature more rapidly.

In general, perfect identity of the temperatures of the two feet is uncommon. It was present in only two of the normal subjects and two of the patients. The general trend is for the feet to be of somewhat different temperatures, with the left foot being

warmer than the right, in the control period. Under anesthesia, the general trend is for the right foot to rise more rapidly than the left.

The mechanisms underlying this variation in reaction between the two extremities is unknown. It is not due to variations in cortical activity between the two cerebral hemispheres since in a previous investigation (*8*) where electroencephalograms and skin temperature measurements were determined simultaneously under cyclopropane anesthesia, the brain waves from symmetrical areas in the cortex presented an identical picture, while the skin temperatures of the feet varied widely. Whether the causative factors lie in subcortical areas or are due to variations in vasomotor tone or anatomic variations in the extremities we cannot say. However, no difference exists between schizophrenic patients and normal subjects in this regard. The diversity between the temperatures of the two feet was of the same extent and of the same trend in both groups of subjects, despite the slightly greater difference between the average temperatures during the control period between the two feet in the patients (.7° C.) as compared with that of the normal subjects (.4° C.).

It may be stated, therefore, that so far as vaso-dilatation as produced by anesthesia is concerned, the reaction of schizophrenic patients is not abnormal. Since this reaction is due purely to paralysis of nervous tissue, the results are of interest in contrast with those found in another study (*3*) in which the schizophrenic patient after the administration of dinitrophenol did not have as marked an increase in oxidative rate, skin temperature, or insensible perspiration. Since vaso-dilatation in the latter instance is due purely to increased heat production in the tissues, it is suggested that in this respect the neurogenic mechanisms in schizophrenia are quite capable of a normal response.

## Summary

In view of the possibility of dysfunction of the autonomic nervous system in schizophrenia, a study was made of the effects of vasoparesis by anesthesia on the skin temperature in ten normal and ten chronically ill schizophrenic subjects. The surface temperature of both feet was measured before and during the induction of deep anesthesia by cyclopropane. It was found that with the induction of anesthesia the temperature of the feet rose sharply but not at an equal rate of speed. The schizophrenic patients behaved similarly to the normal subjects both in the rate and rapidity of the rise of temperature and the diversity in behavior of the two lower extremities. It is concluded that the neurogenic mechanisms in schizophrenia are capable of a normal response to vasodilatation induced by anesthesia.

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PSYCHOSOMATIC MEDICINE—VOL. III, NO. 2, APRIL, 1941

# KYMOGRAPH RECORDS OF NEUROMUSCULAR (RESPIRATORY) PATTERNS IN RELATION TO BEHAVIOR DISORDERS*

A STUDY IN PHYLOBIOLOGY

TRIGANT BURROW, M.D., PH.D.**

"Mankind is a single great organism temporarily divided into pieces—the individuals," H. S. Jennings, "Biology and Social Reform," *Journal of Social Philosophy*, 1937, Vol. 2, p. 163.

## I

## INTRODUCTION

THIS BRIEF COMMUNICATION is a report of experiments in behavior adaptation and of the kymograph records obtained in connection with them. The interest of these experiments lies in the possibility of establishing physiological data respecting the organism's basic motivation. These data afford evidence of the existence in man of a plane of adaptation that is based upon a principle of functional unanimity or behavioral solidarity throughout the species (*10*). The behavioral consistency or species solidarity I have in mind is comparable in its function to the primary principle of solidarity which has been described as characterizing other animal communities (*1*, *2*, *13*).

Behavior may be defined as the consistent series of processes which mediate the organism's relation to its environment. This organism-environment relationship, however, has undergone marked modification in man. In consequence of this modification man's behavior today is largely symbolic and affective. It is motivated through personalistic experiences gathered and compounded of impressions which are mediated by the symbolic segment and which are purely partitive, ideological (*3*). Through the mechanism of projection this affecto-symbolic usage in man has intercepted the organism's immediate contact with the surrounding world and substituted for it a merely wishful orientation. Thus the wisdom of the body with its primary organism-environment relationship is largely subordinated to the wisdom of the head with its partitive reactions mediated inter-individually through the symbol and its adherent affects. The investigations of my associates and myself indicate that this wishful system of motivation, this affecto-symbolic plane of behavior, entails socio-biological implications which make necessary careful examination and revaluation of man's behavior in its organism-environment relationship (*4*).

As psychopathologists we have long recognized that the outstanding characteristic of the psychoneurotic personality is his difficulty of communication or his inability to get along with the world about him—his inability to affiliate himself with the average social

* This paper is part of an experimental report to be published later in book form, and serves to present certain instrumental measures referred to at the conclusion of my book, *The Biology of Human Conflict*. As originally outlined this report was read at the Ninety-fourth Annual Meeting of the American Psychiatric Association, San Francisco, June 6, 1938.

I wish to acknowledge the courtesy of the Morton F. Plant Hospital, Clearwater, Florida, in kindly placing at my disposal the laboratory in which part of the experimental work was done.

** Scientific Director, The Lifwynn Foundation, New York.

reaction. The investigation of social groups, however, gives indication that this impairment in facility of communication with others, conceded to be the special earmark of the neurosis or psychosis, characterizes also the level of adaptation that constitutes man's social reaction-average. For example, in the average social reaction we find that symbols are habitually employed with a substitutive intent that is no different from the substitutive reactions of the deviate neurotic. Like the symbols or language of the neurotic, the social symbols of common usage are equally employed for defense, self-protection, and disguise rather than in their primary function of communication. There is the element of repression, the mechanism of projection, self-consciousness, over-accentuation of the self-image, the sense of guilt, and endless correlated manifestations. Evidence shows increasingly the existence of such factors common equally to the community and to the deviate neurotic individual. It shows that in man's customary social interchange there exist the same obstructions to communication that characterize the wishful impediments of the neurotic personality (*5*).

This observation led us to an altered view of the pathological factors operative in the field of behavior generally. It compelled us to abandon the basis of observation which regards the community's affecto-symbolic reaction-average as the criterion of the organism's behavior. In consequence, it compelled us to relinquish standards of evaluation which measure the deviation of the psychoneurotic by comparison with this average community reaction. Having recognized certain factors as common alike to the psychoneurotic and to the community, we examined both the psychoneurotic and the social reaction-average as cognate processes and sought to determine the common denominator underlying both these behavior manifestations. In order to study this material for whatever common behavioral features it contained and ascertain the common denominator underlying it, it was necessary to establish a consistent and permanent criterion to serve as a universal norm of behavior against which we might measure the incidence of all deviate processes, both individual and social. It was in the effort to discover the primary organismic substrate on which man's difficulties of adaptation are superimposed that the experiments here described were originally undertaken. We wished to establish a dependable demarcation between two levels of adaptation—on the one hand the affecto-symbolic level characteristic alike of the neurotic and the average community reaction and, on the other, the level of reaction which in its behavioral consistency would represent the primary behavior of man in its immediate organism-environment relationship.

As this organismic approach to man's behavior envisages a condition of pathology that is not limited to any single individual or to any single community, but relates to processes common to man as a phylum, I have called it *phylopathology*, and the science that deals with the consistent coordination of functions within this phylo-organism I have called *phylobiology* (*3*, *6*).

## II

### Mechanism and Technique

In order to facilitate the disclosure of the common denominator underlying the reaction represented equally in the deviate neurotic and in the social reaction-average commonly called normal, my associates and I undertook the examination of the behavior of both neurotic and normal individuals in relatively small social or group settings

(from 6 to 12 persons). As group-analysis had brought to light inadequacies of interrelation or communication on both the neurotic and the average-reaction level, a special feature of the phyloanalytic technique was the effort to examine in detail the community's customary behavior-expressions on this affecto-symbolic plane.[1] This examination required that we arrest and challenge the habitual inter-personal reactions of both the normal and the neurotic individual on their accustomed behavior-level. As a result of this interception and rebuff directed toward habitual affecto-symbolic reactions occurring in our experimental groups, there was early noticeable a difference in behavioral adaptation with respect to this prevailing level of communication. It was observable that the ideological and partitive habits of interest and attention within the group had become definitely embarrassed and frustrated. Denied its customary social outlets, this normal process of affective projection and adaptation was thrown strongly back upon itself, and what had been a comfortable mode of social inter-reaction revealed the presence of marked inter-personal impediment and discomfort.

This frustration of the affecto-symbolic or partitive orientation forced upon the experimenters as well as upon the other subjects an internal modification in the organism's mechanism of adaptation. Coincident with this adaptive alteration a mode of attention or interest began to assert itself which contrasted sharply with the usual mode of attention and adaptation that characterizes the affecto-symbolic reaction-level. This altered mode of attention I called *cotention*. As the kymograph records relate specifically to internal modifications occurring in this mode of attention, I should like, before proceeding to these records, to describe as far as possible the mechanism of cotention and to state the instructions given the subjects in attaining this attentive mode. The reader should keep before him that the kymograph tracings of cotention are a record of a modification in attention or adaptation induced in a group or inter-individual setting and that therefore they must be regarded as inseparably bound up with a group or community reaction.

Like attention, cotention may be described only in terms of its pertinent characteristics. Obviously where we found ourselves confronted with this definite modification in customary interest and adaptation, it became our task to approach this community alteration in adaptation through methods consistent with experimental medicine elsewhere. It became our task to discover in terms of internal physiological modifications in just what this difference in group adaptation consisted. Realizing the part played by eye-movements in man's organism-environment adaptation, our procedure was assisted through recourse to a technique which sought to regain kinesthetic control over the position and movements of the

[1] It would be of value if at the outset it were understood that the group method of analysis, or phylo-analysis, is a procedure which bears no relation to the recently adopted measures of treatment now conducted under the name of group-therapy. In these forms of therapy the physician or psychiatrist with his particular constellation of influences and training necessarily attempts to adjust from this ideological (partitive) background the influences and habituations that constitute the ideological background of his patients (7). In view of the basis upon which our phylo-analytic inquiry set out, it is hardly necessary to say that my associates and I could not possibly assume a stellar rôle in the societal setting under investigation. As phyloanalysis presupposes an examination of both the individual neurosis and the normal reaction-average, the material examined is common to all persons. So that, except for the technical controls which we were under scientific obligation to preserve, we who were experimenters were at the same time necessarily experimentees. The all-inclusiveness or the relativity, so to speak, of our program of observation—the inclusion of the behavioral elements observing as well as the behavioral elements observed—is a fundamental principle in phylobiology.

eyes as they function in the process of symbolic motivation and attention. From this internal, stereognostic background of ocular control it became possible to maintain the eyes in a more or less central position of fixation. Where there was acquired this facility in arresting eye-movements, two distinct phenomena were observed: one of these was psychological and consisted in the absence of affect-images or preoccupations; the other was somatic and consisted in a reduction of the rate of respiration.

As I have said, practical interest naturally centered in the particular element of the cotentive pattern which was subject to voluntary control, namely, the eye-movements. But, if I may speak of my own response, I did not at first attempt to restrict the eye-movements with any conscious idea of inducing cotention. The first intimation of cotention occurred automatically with me in response to frustration in group or inter-individual communication. My first reaction to this frustration, which occurred only after continued experimentation, was an indefinite sense of stress or tension in the head. With the repeated recurrence of the cotentive reaction this cephalic tension appeared to be anteriorly located. It seemed to be localized chiefly in the brow and eyes and in the area back of the eyes. It was only as the tension became more circumscribed that I noted that kinesthetic control of the eye-movements contributed to induce cotention. But in the beginning cotention was not a reaction producible at will.[2]

As this sensation of stress became more clearly defined within the anterior portion of the head, there was the coincident awareness of an altered tensional tone distributed generally throughout the body. This altered tensional pattern appeared to constitute a background or foil, so to speak, against which the localized cerebro-ocular pattern stood out in sharp relief. As these tensional patterns represented physiological alterations which were concomitant to our experimental interruption or frustration of the affecto-symbolic reaction-level in both neurotic and normal, these physiological alterations were of special interest to us. Needless to say, this interest was greatly enhanced in connection with our effort to establish in the organism a more basic level of motivation and behavior. With this in view there was a redoubling of the effort to retain the eyes, which for the most part were kept closed, in a position of complete rest and relaxation. Again it should be emphasized that in so far as this posture of the eyes was maintained, it was maintained from a purely kinesthetic sense of the eyes and their muscular appendages. Even where cotention was induced with open eyes it was necessary that their fixation be preserved through an internal balance in muscular tone and not through fixation upon some external point.

With regard to the instructions given to student-subjects there is no formal difficulty. After all it is simple enough to describe a procedure with which one is himself familiar. The difficulty is that cotention is a behavioral mode to which volitional habits of attention on man's present behavioral level run counter, and a technique requisite to induce co-

[2] "Will" is hardly the word, as willful action is closely linked up with partitive affects and the symbolic segment. However disguised, there is normally present in our partitive, inter-personal relations a sense of obstruction and discomfort which cotention, with its arrest of eye-movements, appears in a measure to relieve. As difficult as it is and as elusive, there is nothing exotic about the cotentive reaction. This modification is one of sheer internal orthopedics. The situation may be compared to that of a typist who shifts to the touch system after long habituation to visual typing. He undergoes a definite alteration in internal pattern, but one would hardly say that this modification has been produced by an effort of the will. Rather the process has been the slow, automatic acquisition step by step of a controlled technique in behavior.

tention is accordingly opposed by established social prejudice. It has been my procedure to have the subject assume a recumbent posture or a comfortable sitting position. I then instruct him to close his eyes and, as far as possible, maintain them in a state of relaxation. I explain to him that this procedure is assisted by letting the eyes rest upon a point which he may picture as forming the center of the curtain of darkness in front of him. By way of helping the student to attain his visual fixation solely through his kinesthetic sense of the eyes, I usually cite the difference between holding the outstretched arm steady by grasping with the hand a stationary object, and holding the arm steady without the aid of this external support. In the latter case the subject's sole guide as to its position is his sensation of the weight and muscular tension in the outstretched arm. In order to avoid introducing an element of suggestion our instructions to subjects and patients were restricted to the simple formula just outlined.[3]

The fact cannot be too strongly stressed that by virtue of neuromuscular reaction-habits long established within the species, man is now averse to any alteration which challenges his accustomed neuromuscular pattern of adaptation. As individuals and as social groups we are now reflexly conditioned to adhere to a pattern of adaptation which ingrained neural habits render wholly opposed to the cotentive pattern. On this account it should be emphasized that it was necessary to repeat the instructions very many times as well as to demonstrate again and again my own cotentive reaction.

The adoption of this procedure or technique on the part of my associates and myself led to the observation of a varied series of processes. These processes were fairly consistent in the order of their occurrence with each of us but differed in duration and in the prominence of the several steps involved. If I may speak again of my own reaction, these stages were approximately as follows: Having succeeded in fixing the attention upon the subjectively determined "center of vision," it was found that habitually projected mental images tended more and more to be eliminated and that mental preoccupations tended correspondingly to be superseded by an internal kinesthetic awareness of strain and tension within and behind the eyes. Where, after repeated trial and error, consistent awareness of these tensions within and behind the eyes was obtained, there invariably occurred a reduction in the rate of respiration. In contrast to normal attention this organic modification in the attentive pattern appeared to extend into the deeper neural and muscular structures generally. The sensation of stress or tension in the anterior part of the head and in the eyes now began to recede more and more and to be replaced by sensations of tension which seemed to be less confined locally and to occupy a position that appeared more central and coterminous with the body's tension as a whole. As the alteration in respiration was the outstanding modification in this altered pattern of attention, or in cotention, we wished to make a more precise study of this phenomenon as well as to look for other physiological modifications that might lend themselves to instrumental recording.

The brain is of course the organ whose function is of central importance in relating the organism of man to the environment, whether this occurs through the organism's primary reaction as a whole or through its sec-

[3] A previous description of this technique and of the physiological modifications involved in it may be found in my book, *The Biology of Human Conflict* (6, pp. 266–270; see also pp. 285–290, 329–330 and Chapter V).

ondary symbolic reaction to the outer world. We should, therefore, expect to find that whatever overlapping or conflict exists between these two behavior-systems would manifest itself in a differentiation of function in the brain and in certain parts or organs connected with it. It is this differentiation in cerebral activity and in concomitant alterations of the respiratory function which appear to be indicated in the kymograph records presented.

## III

### Instrumental Experiments and Results

The first series of experiments was begun in the summer of 1937 and was continued throughout the following year. The apparatus used for recording the respiratory curves was the wax paper kymograph constructed by Volkmann & Gerbrands of the Harvard Psychological Laboratory, the instrument having been specially modified for our purposes. This kymograph is electrically driven and permits the taking of continuous records over a period of several hours. Tracings were obtained of the thoracic and abdominal respiration by means of rubber tube pneumographs, and of the carotid pulse by means of a Lombard tambour. The time was registered on the record in intervals of five seconds and there were two signal-markers, one for the subject and one for the experimenter.

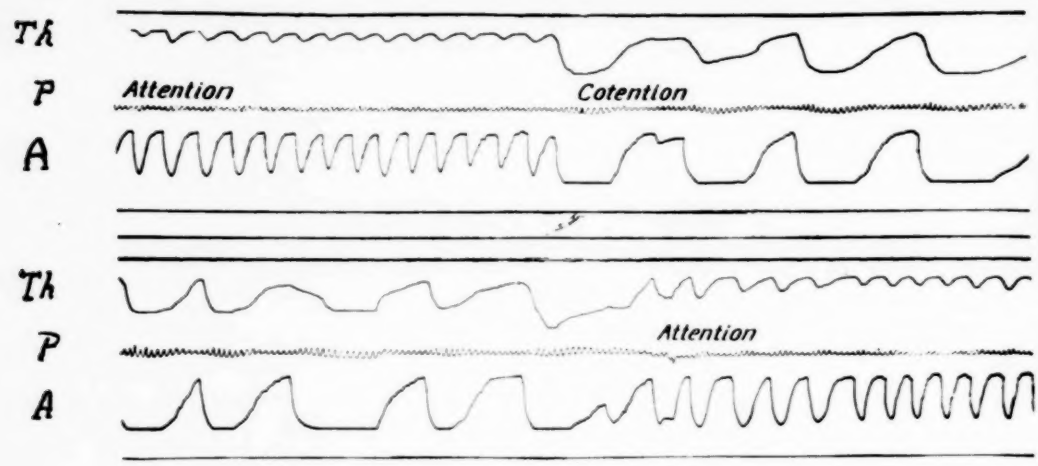
The experiments were undertaken on sixteen individuals, ranging in age from 17 to 63 years, eight males and eight females. The experimental periods varied from thirty minutes to two hours. With a few individuals the experiments were repeated many times and with several experimental variations, whereas the records of other subjects served chiefly for determining the average conformation of the respiratory curves (*8*).

In seven subjects the condition I have described as cotention was specially investigated. The data are here given of those three subjects on whom most numerous records were obtained. The results (Table 1) were treated statistically to determine the standard deviation, probable error, differences in probable error and the validity or critical ratio of the data obtained. By pooling the data for the three subjects we find that there were 103 minutes of cotention (56 periods varying from one to ten minutes) and these were compared with 106 one-minute samples of the subjects' respiration during the course of normal attention. The most consistent alteration was, as mentioned, a marked decrease in the *respiratory rate* which dropped from an average of 13.22 movements per minute in normal attention to an average of 4.43 in the cotentive period. With none of the three subjects was there an overlapping of the respiratory rate in attention and cotention, and the difference in rate was found to be statistically reliable. With this decrease in rate there was an increase in the thoracic and abdominal amplitude of the respiratory movements which, however, was not proportionate in degree nor quite so consistent as the decrease in frequency (see figure). In one subject the inspiration-expiration ratio was markedly decreased (that is, the expiration disproportionately prolonged), but this marked change did not appear so definitely in other subjects. The pulse rate did not show any changes that were statistically reliable.

TABLE 1

| | *Frequency* | | *Range* | |
|---|---|---|---|---|
| | *Attention* | *Cotention* | *Attention* | *Cotention* |
| A | 14.61 | 3.73 | 11–24 | 2.5–5.7 |
| B | 11.26 | 4.22 | 8.1–14 | 2.7–6.7 |
| C | 13.80 | 5.95 | 12–16.6 | 4.8–7 |
| Average | 13.22 | 4.43 | | |

It may be added that these respiratory alterations set in immediately with the alteration of the attentional pat-




FIGURE

Th: thoracic respiration
P: carotid pulse
A: abdominal respiration

Inspiration is recorded on the down-stroke, expiration on the up-stroke.

tern. They occurred automatically and were not brought about by any voluntary effort or conscious manipulation. The respiratory changes, as they occur during cotention, do not show any similarity to the slight modifications observed in sleep and sleepiness, in mental effort or emotional excitement, or under conditions in which the subject focuses upon external objects or upon bodily tensions in regions other than those of the symbolic segment. In the period of normal attention immediately following cotention there was no compensatory acceleration in the breathing rate. But where subjects were instructed to retard the frequency of breathing consciously, while maintaining normal attention, the records showed a subsequent acceleration.

A further series of respiratory measurements was taken with the Jones basal metabolism apparatus on the same three subjects. These experiments were undertaken in the fall of 1939. The procedure adopted was that ordinarily employed in basal metabolism tests. In this way dependable spirometric curves were obtained. We shall here give only those results which may serve as a control and amplification of the experimental series just reported. Other findings will be reported in the longer communication.

A glance at Table 2 will show that in these experiments the trend is similar to that shown in the earlier series.[4] For all three subjects the *frequency* of respiration was markedly lower in cotention than in attention. By combining the data for the three subjects we compared 239 minutes of cotention in 56 periods ranging from two to five minutes each, with 249 minutes of attention comprising 64 periods of three and four minutes each. The respiratory rate dropped from an average of 9.74 movements per minute in normal attention to an average of 2.64 in the cotentive period. Again there was no overlapping for any one of the three subjects in the distribution of the respiratory rates in attention and cotention. There can be no question, there-

[4] The fact that the respiratory rates in both attention and cotention were generally slower in the recordings with the metabolism apparatus as compared with the earlier recordings with the kymograph is perhaps accounted for by the fact that in the metabolism series a mixture was inspired which was richer in oxygen than is ordinary air.

fore, as to the validity of the difference in rate under the two conditions.

The records obtained from the basal metabolism apparatus made it possible to secure additional respiratory data, namely, the *minute-volume* of air inspired, the *tidal air*, and the *oxygen-utilization* of the subjects. The *minute-volume* was calculated by measuring the individual inspiratory strokes through a specified portion of the experimental periods and adding the figures obtained. As it is known what amount of air-volume a specified length of amplitude represents, the minute-volume may be directly calculated from the basal metabolism charts. This procedure is laborious but it is more exact than merely determining the mean respiratory amplitude and multiplying it by the respiratory rate. It will be seen from Table 2 that in all three subjects

TABLE 2

| | *Frequency* | | *Range* | |
|---|---|---|---|---|
| | *Attention* | *Cotention* | *Attention* | *Cotention* |
| A | 9.42 | 1.72 | 7.75–11.00 | 1.35–2.35 |
| B | 10.76 | 3.00 | 9.33–13.06 | 2.08–4.45 |
| C | 9.03 | 3.20 | 6.81–11.00 | 2.80–3.94 |
| Average | 9.74 | 2.64 | | |

| | *Minute-Volume* | | *Range* | |
|---|---|---|---|---|
| | *Attention* | *Cotention* | *Attention* | *Cotention* |
| A | 5.08 | 3.27 | 4.26– 6.38 | 2.47–3.90 |
| B | 8.64 | 4.44 | 6.24–12.12 | 3.24–5.45 |
| C | 7.15 | 4.53 | 5.84– 8.31 | 3.94–5.56 |
| Average | 6.95 | 4.08 | | |

| | *Tidal Air* | |
|---|---|---|
| | *Attention* | *Cotention* |
| A | 0.53 | 1.95 |
| B | 0.80 | 1.48 |
| C | 0.79 | 1.41 |
| Average | 0.74 | 1.61 |

the minute-volume in cotention was markedly less than in attention. If we pool the results we find that the average minute-volume of air inspired by the three subjects dropped from 6.95 liters in attention to 4.08 liters in cotention. As there was no overlapping in the distribution of minute-volumes during cotention and attention for any of the three subjects, again there can be no question as to the validity of the difference in minute-volumes under the two experimental conditions.

These values may also be expressed in terms of *tidal air*. Although the drop in minute-volume is definite and consistent in each of the three subjects, it will be seen that the relative decrease is not so great as is the case in regard to frequency of respiration. In other words, the amount of air inspired per inspiration was greater in cotention than in attention. This measure of the tidal air is calculated by dividing the minute-volume by the respiratory rate. The average tidal air for the three subjects was 0.74 liter in attention and 1.61 liters in cotention. This corroborates the findings made by direct observation as well as by the recorded tracings (kymograph and metabolism apparatus) that the respiratory movements are deeper in cotention than in attention. On the other hand, as just mentioned, the total air inspired per minute in cotention does not equal the total amount of air inspired per minute in attention.

With regard to the *oxygen-utilization*, the oxygen absorbed per minute, when averaged for the three subjects (Table 3), was about the same in attention

TABLE 3

| | *Oxygen Absorbed per Minute* | | *Oxygen Utilization* | |
|---|---|---|---|---|
| | *Attention* | *Cotention* | *Attention* | *Cotention* |
| A | 0.19 liter | 0.21 liter | 3.81% | 6.26% |
| B | 0.24 " | 0.22 " | 2.92% | 4.94% |
| C | 0.24 " | 0.22 " | 3.46% | 4.94% |
| Average | 0.23 " | 0.22 " | 3.39% | 5.38% |

and in cotention, namely, 0.23 liter for attention and 0.22 liter for cotention. From these data we can calculate the relation of the oxygen absorbed to the total volume of air respired per minute. We realize, of course, that it was not pure oxygen but an air mixture of high oxygen content which the subjects breathed and which is to be compared with the oxygen actually absorbed. The

percentage is obtained by dividing the oxygen absorbed per minute by the minute-volume of air. As would be expected on the basis of the values already given, the results show that for all three subjects the percentage of oxygen utilized was markedly higher in cotention than in attention, namely, 5.38 per cent as compared with 3.39 per cent. That is, in cotention when a smaller volume of air is breathed per minute, a larger part of the available oxygen is utilized than under conditions of normal attention. But as just mentioned, the average amount of oxygen actually absorbed in the attentive and cotentive reactions is about the same.[5]

## IV

## Discussion

A great deal of material has been assembled by various experimenters regarding modifications of breathing in attention, in mental effort and in emotional reactions. In this brief communication I shall not review the many experiments reported in the literature concerning respiration in relation to behavior. Suffice it to say that the review of the literature did not reveal respiratory changes of the type which are reported here.

Various discussions emphasize that respiration is a very fine reagent to psychic stimuli, a circumstance which may have to do not only with the central importance of respiratory processes for all life phenomena but also with the fact that different levels of cerebral function are involved in the innervation of respiration. The respiratory rhythm is controlled not only by the medulla oblongata, but neural impulses from the hypothalamus and from the cortex also bring about certain modifications in breathing. This complex innervation makes it understandable that behavior-reactions are reflected in respiratory changes. The cortical as well as the hypothalamic regions are closely tied up with behavior-patterns, and any behavior modifications that affect these cerebral areas may naturally be accompanied by respiratory alterations.

The results reported afford more concrete evidence of the fact that in behavior we have to deal with certain neural patterns and that there is the possibility of discriminating on a neurological level between two immediate behavioral orientations. One of these we have defined as the affecto-symbolic level habitual to normal and neurotic individuals, the other as the basic coordination of man in his primary organism-environment relationship. Cotention appears to be allied with a reaffirmation of this more basic orientation, for, in reverting to the cotentive mode, affecto-symbolic contents and partitive preoccupations are relinquished in favor of the total pattern. With the dominance of this total pattern we find that tensional strains relating to the eyes, but not ordinarily recognized, are brought to awareness, and that at the same time there is the automatic recovery of tensional patterns governing the organism's primary adaptation to the environment. We probably have to do, at least in part, with the awareness on the one hand of restricted motor patterns related to the organism's symbol activity, and on the other we have to do with motor patterns that represent the activity of the organism as a functioning whole. In the cotentive adaptation the total pattern is dominant, and forms, as it were, the background against which the localized special pattern is sensed and demarcated. The fact that we are dealing with sets of motor patterns makes it understandable that this internal shift in pat-

[5] I may mention that other physiological part-functions are in process of study and recording—such as modifications in eye-movements as reproduced photographically, changes in brain-rhythm and potentials and in cardiovascular reactions.

tern described as cotention is intimately related to a wide behavioral alteration; that it is related to a shift or change in outlook, attitude and adaptation and to the inter-environmental reactions of the organism generally.

Cotention originated as a group process and is, therefore, essentially a social as well as an individual phenomenon. This is of interest in connection with our observation that the individual is assisted in recovering his organism's cotentive pattern to the degree in which he finds himself one of a group whose purpose is, in general, hospitable to this altered mode of adaptation. The organismic correspondence between the cotentive pattern existing in the individual and this same pattern as it exists in the group is of vital import from the point of view of human behavior. To be able to trace the biological parallel between the ontogenetic and the phylogenetic aspects of man's behavior, even in the midst of the wide-spread chaos of affecto-symbolic disorders existing in the world today, possesses deep sociobiological significance. This reversion to organismic type should, when given practical social application, contribute materially to preserve the primary viability of man's organism in both its individual and its community processes.

It should be emphasized that the cotentive mode of adaptation did not come about through any preconception on the part of myself or my associates, but was the result of direct experimentation in community or social interrelations. From my early background in psychoanalysis, investigations of the phenomenon of transference and resistance in the neurotic patient led me to a study of this phenomenon and related impediments of communication as they appeared in so-called normal social settings. So that, as I have said, I undertook with a few associates to investigate this transference-resistance dichotomy as it expresses itself in the average social reaction.

Our later experiments with neuromuscular reactions and their tensional interrelations in the individual and in the group indicate that in constructing its social transference-resistance system the organism of man has employed a brain-area or segment that is connected predominantly with the use of the special senses in the production of language, and that this area or segment is very different from that which mediates man's primary organism-environment relationship. This doubtless explains why it was that in our phyloanalytic experiments a persistent challenge to the social alternation of resistance and transference—a challenge culminating in definite affect-frustration—led automatically to a challenge or interception of the function of the affecto-symbolic brain-segment as it reacts inter-individually or socially.

An interesting circumstance from the point of view of behavior is that the three major alterations noted in cotention—diminution of eye-movements, absence of affecto-symbolic images and the slowing of respiration—seemed to belong to one consistent pattern. Of the three observable elements in this configuration, the arrest of the eyes appeared to be the trigger, so to speak, which touched off the altered adaptive pattern. For this kinesthetic arrest of eye-movements and the cerebral modification concomitant to it had the effect not only of retarding respiration, but also of eliminating the projective affect-images which ordinarily mediate the organism's relation to the environment through the mechanism of symbolic attention. As a result of this adjustment by which the usual process of attention becomes freed from its burden of irrelevant social images and affects, the organism's interest and motivation

achieves a direct relation to the environment.[6] The coincidence of the two phenomena—slowed respiratory rhythm and the elimination of affective images—seems to offer a clue to the demonstration of an internal relationship between psychic reactions involving affective images, and somatic reactions involving the organism's physiology of respiration. In short, there appears the possibility of obtaining a clue to behavior-disorders that rests upon objective physiological evidence.

From the evidence thus far gathered, our experiments offer ground for the view that, when students of behavior will have come to regard the various manifestations of deviation or neurosis from the standpoint of its generic phylo-organismic implications, they will recognize in many symptoms of deviation now regarded as "mental" the clear evidence of a definite physiological conflict. They will recognize in terms of immediate physiological patterns of reaction the difference between the behavior that is motivated within the organism's socio-cortical system of motivations (man's symbolic wishes or affects), and the behavior that is motivated organismically, or within man's primary phylo-thalamic segment of activation.

Physiological conflict is apparent, of course, in such socio-cortical reactions as are associated with the obvious vasomotor phenomenon of blushing, with the motor paroxysms of hysteria, with the convulsive lingual and pharyngeal spasms of the stammerer, and with numerous related speech impediments. But from a more inclusive phyloanalytic background, reactions which have always been regarded as ideational or "sensory" and which psychiatry has studied only in their sensory-image content appear also to belong to motor constellations lying deeper and involving the organism's autonomic motivations. Insofar as our observations have been oriented within an organismic frame of reference, there has been indication that man's universal subjugation to unconscious social images with their manifold transferences and countertransferences, individual and social, is also traceable to underlying physiological (motor) processes, (*9*). Every psychiatrist has witnessed the besetting dichotomies of the psychoneurotic with his obsessions, his fears, his compulsions, and the various image-elaborations based upon his ambivalent love-hate preoccupations. But phyloanalytic procedure offers evidence that our social reactions of success and failure, our vacillating periods of elation and depression, our personal irritations and competitiveness, our inter-individual suspicions and social deceptions, our habitual dependencies upon one another, in short, our endless sentimental affect-references, whether in the form of preference or rejection (love or hate), are equally expressions of a common disorder possessing a demonstrable physiological basis (*11*).

If beneath the various expressions of wishful, deviate thinking or neurotic behavior there is differentiable a deviate physiological (partitive) pattern common to behavior-aberration generally, then the control and adjustment of this common deviate pattern would mean the control and adjustment of neurotic or wishful thinking and behavior throughout the community generally. This broader, more organismic program of readjustment has characterized the aim of medicine within other domains of pathological inquiry, and it

[6] Once acquired, this altered kinesthetic adjustment prevails undiminished throughout one's ordinary activities—in one's thinking, in his writing, his social interchange and in his commonplace interests and activities of whatever kind. Cotention is thus a sort of balance-wheel which, like the mechanism that at all times maintains the physical balance of the body, maintains one's social and environmental relationships upon an even keel.

is therefore not unnatural to expect that a similar adjustment of method and aim will also take place in the sphere of maladjustments that relate to human behavior in its inter-individual aspects.

The definite experimental objective before us was and is, obviously, the development of a technique through which it may be possible to influence disorders of behavior, individual and social, through direct physiological measures of control. The decrease in respiratory rhythm is, of course, only a part-feature of cotention, but it affords tentative evidence of the organism's susceptibility to modifications in its internal physiological processes as they affect man's organism-environment relationship.

Specifically it has been possible in our group experiments to make a beginning of separating *en masse* the neuromuscular pattern of reaction which motivates the organism's wishful or deviate behavior from the neuromuscular pattern of reaction which as a total mass or configuration insures the organism's consistent motivation in relation to the actual environment. We were able to demonstrate the presence of conflict between these two patterns. This conflict in the distribution of the organism's internal tensional patterns affecting the behavior of man as a species or phylum was shown to be due to the dominance of a socially acquired trait or character of relatively recent attainment in the evolution of the species. I refer to the dominance in man today of the physiological pattern associated with his symbolic system of communication as contrasted with those basic reactions that primarily integrate the phylum as an organismic whole (*12*). The first or symbolic constellation of reactions is that which relates to what I have called the organism's *socio-cortical segment* of reactions in contrast to the constellation of reactions belonging to the *phylo-thalamic segment* of man's organism.

If we are correct in our interpretation thus far, the induction of cotention, or of a species of attention which relates the individual and the community to the environment organismically, represents an effort to swing the entire wishful or affective system of adaptation from its currently reflex habituations and to recenter this entire constellation of reactions within the organism's primary system of motivation. The difficulty technically of effecting such an alteration in socio-symbolic habit can hardly be estimated. In confronting the common factors underlying our socio-biological material, we are evidently face to face with a social and cultural problem as well as with a problem in the neurophysiology of man's organism in relation to the environment.

Whatever has been attained thus far by those of us engaged in this phylobiological investigation has been attained only in partial measure and then only after long and repeated experimentation. Undoubtedly there is the need of greater knowledge regarding the meaning and interrelation of the physiological modifications reported. And in submitting the data of our investigations, I should like to voice the need not only for additional data, but also for additional guidance in respect to these data from different scientists in widely separated fields in order that the clearest, most rounded and fullest interpretation of the material under investigation may be obtained.

## Summary

This report gives briefly the results thus far obtained from experiments the purpose of which has been to demonstrate differences of behavior through objectively recordable measures. The data presented were the outcome of

group investigations of modifications in internal patterns which, in turn, resulted from a series of phyloanalytic experiments on affect-frustration in social groups. Instrumental recordings were made of physiological alterations concomitant to differences in behavior. Respiratory curves recorded by the kymograph and by the basal metabolism apparatus showed a difference between two types of attentional adaptation. Specifically, a difference was found in physiological (respiratory) processes according 1) as the organism functions as a total pattern of response, or 2) as there is the dominance of the secondary, symbolic reaction-pattern characteristic of neurotic and of so-called normal behavior.

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# THE EFFECT OF THE EMOTIONS UPON DIAPHRAGMATIC FUNCTION

## OBSERVATIONS IN FIVE PATIENTS

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MORE AND MORE, attention is being focused upon the emotions as an influencing factor in the function or dysfunction of the various bodily organs. And the rôle that joy, elation, and contentment play, can readily be distinguished from the opposite action of inadequacy, insecurity, anxiety, depression and frustration.

In a previous paper (*1*) we showed that one could prove conclusively, by esophagoscopic examinations, that the suggestion of undesirable environments caused esophageal tightening, and narrowing of the esophageal lumen. While proposals of a pleasant situation brought about a prompt relaxation of the spasm, and return of the lumen to its normal size.

This is, of course, what the psychiatrists have been teaching for years. Yet, indisputable, objective substantiation of their claims not always being possible, much skepticism existed as to the truth of such beliefs. As far as the esophagus is concerned, however, our observations serve to vindicate the psychiatrists.

Furthermore, we observed bronchoscopically three patients in whom pleasant and unpleasant suggestions caused alterations in the size of the bronchial lumen that were similar to those already mentioned in connection with the esophagus. The significance of these observations are quite evident in relation to the cause and treatment of asthma, (*2*).

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### DIAPHRAGMATIC OBSERVATIONS

Not being especially enthusiastic proponents of the emotional school of thought, we were greatly surprised when, during a fluoroscopic examination, we unexpectedly and unintentionally elicited an alteration in the range of movement of the diaphragm while discussing certain subjects, which, to the patient, were varyingly pleasant and unpleasant.

This patient had come to the clinic seeking relief of a multiplicity of vague symptoms that were referred to the head, chest, abdomen, rectum, and even the extremities, when actually his chief difficulty seemed to be that he was worrying about economic uncertainty and insecurity.

Relative to the evaluation of our observations, it is important to remember that during the fluoroscopic examination he was at no time asked to breathe in any particular manner, and in fact, since we made no reference to the respiratory system, he had no way of knowing just which organs were being studied. This kept our findings entirely objective.

His initial breathing was shallow and the diaphragm showed a respiratory movement that was constantly limited to $\frac{1}{2}$ inch. But when he was asked to imagine how he would feel, if, upon leaving the clinic, he should find ten

dollars in the street, there was an immediate increase in the range of respiratory diaphragmatic movement to $3\frac{1}{2}$ inches. This new diaphragmatic status was maintained so long that we began to wonder whether there was an actual relationship between it and the pleasant possibility of finding ten dollars, or whether the changed diaphragmatic movement was merely co-incidental.

To test this point, we asked him to imagine how he would feel if the money blew out of his hand and disappeared. With this unpleasant thought, the diaphragm promptly refused to move more than $\frac{3}{4}$ inch with each respiration. The periods of enhanced and restricted diaphragmatic action were re-elicited in this patient when he was asked to imagine himself living through first the pleasant, and then the unpleasant situations that we proposed. And hence, the relationship of thought and action seemed more than coincidence. Nevertheless, the question arose as to whether the diaphragmatic response to emotional stimuli was inherent in this patient only, or whether it might also occur in others.

Sitting in the waiting room were four other patients with almost identical complaints and equally distressing economic statuses. What would be the response of their diaphragms to suggestions of desirable and undesirable environments? Fluoroscopic examinations were made.

In three of these the diaphragm reacted immediately, and exactly as noted in the original patient. But the fourth member of this new series, a jobless, morose, sullen man of 55, showed no diaphragmatic alteration to the environmental proposals.

## Discussion

It is interesting to note that this last patient, whose diaphragm failed to react to our suggestions, was also the one exception in our esophageal series, (*3*). He failed to show the prompt esophageal narrowing and relaxation that was so clear cut in the others following emotional changes.

Yet, one should not forget that these reactions come from within the patient. Consequently, a person's emotions and the physical changes resulting therefrom are strictly individual matters. For the physical reaction to a particular suggestion or environment is determined by the light in which the patient views the situation. In other words, by the emotions which are aroused rather than by the situation per se. And if the emotions are unaltered, no change in the diaphragmatic movement should be expected.

## Clinical Application

This is a very broad subject. It is not only of concern to the physiologist, psychologist, and psychiatrist, but also to the clinician, because, in our opinion, these originally transient bodily alterations may become permanent and produce first a disturbance of function and ultimately definite organic disease.

Does this emotionally-altered diaphragmatic movement influence the function of neighboring or distant organs? We believe that it does. Our four patients, who showed diaphragmatic alteration, also had subjective and objective esophageal dysfunction, which was proved on esophagoscopic, roentgenologic, and fluoroscopic examinations.

Furthermore, Jackson (*4*) states that the diaphragmatic crus acts as the "pinch cock" of the esophagus, and normally causes hiatal closure so that food will not be regurgitated from the stomach into the esophagus. Is it not reasonable to presume, therefore, that an emotionally tense, spastic diaphragm and crus would bring about a "tighter than normal" pinch-cock ef-

fect upon that portion of the esophagus which it encircles, and thereby cause such closure that cardiospasm would ensue?

Our diaphragmatic observations add support to Jackson's theoretic, anatomic, and esophagoscopic conception of the mechanical-etiologic factor in cardiospasm, or, as he prefers to call it, "phrenospasm." In addition, our studies seem to show that the "pinching" action of the diaphragm is under the control of the emotions, and can, thereby, be intensified or diminished.

The association of a neurotic temperament and cardiospasm is a well recognized clinical entity; but I am not aware of previous work showing that the emotions acted through the diaphragm and secondarily upon the esophagus in the production of the cardiospasm.

## Conclusions

1) The range of diaphragmatic movement in patients can be altered by suggesting imaginary situations which arouse strong emotions. If these emotions are pleasant they cause increased amplitude of diaphragmatic movement; while the unpleasant type restrict it.

2) We believe that idiopathic cardiospasm is caused primarily by unpleasant situations, either real or imagined, which produce unpleasant emotions. The effect of these emotions may possibly be manifested through the diaphragm in such a manner as to tighten the esophageal diaphragmatic pinchcock.

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# A CLINICAL NOTE ON A MECHANISM OF PSYCHOGENIC BACK PAIN

LEON J. SAUL, M.D.*

IN HIS ARTICLE Fetterman (*3*) has emphasized the exaggeration of back pain for neurotic reasons. One point is worthy of further stress in this connection, namely that back pain, like many other psychosomatic symptoms, may result from an actual local physical condition which is exacerbated or possibly entirely caused by emotional tensions. It has been noted that emotional tensions produce physical effects, often during sleep, such as, nocturnal teeth grinding, (*4*). Of a number of analyzed patients with back pain, one recently showed such a mechanism in especially clear form. This patient was a young man whose extreme ambitious competitiveness was largely a reaction to strong underlying dependence. He developed severe back pain with tenderness in the 4th–5th lumbar region on just four occasions each of which was when the analysis was temporarily interrupted. He reacted with rage which, however, was repressed. At these times it appeared in his dreams which were filled with violence and muscular activity, for example:

*Dream 1:* I race a man and run very fast.

*Dream 2:* I am pounding something down into a barrel.

*Dream 3:* I come at a man with a heavy knife and split him in half.

*Dream 4:* I lead some people over a very difficult path, carrying a load on my back. It is a test. I awake with legs crossed and rigidly tense.

At other times in the analysis when the patient was not acutely angry and had no back pain, his dreams were much quieter, for example:

*Dream 1:* I am appointed to an important position.

*Dream 2:* I am in a locker room. It is almost time for some game I am to play in, to begin, but I cannot find my clothes.

At the periods of repressed rage and dreams of extreme violence and activity, the patient noticed that when he awoke during the night or in the morning his body musculature was so tensed that he was "rigid as a board." His legs would be rigidly extended, often with his ankles locked together and pulling against each other. If he retired without removing his wristwatch, he would find in the morning that his movements during sleep had forced the stem of the watch into the back of his hand, making his hand bleed.

Such muscular contractions during sleep, as in epileptoid conditions, can be of great force. It is difficult for most people who grind their teeth at night to do it as loudly when awake. The observations in the case here mentioned indicate that such contractions of the trunk muscles during sleep either caused the local back condition or exacerbated a condition which had been present. The orthopedist in the case could find no evidence of local pathology and rejected a diagnosis of slipped disc. The patient's repressed rage caused muscle contractions during sleep which caused the back pain and tenderness. If this is the case, the sympton would have no

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direct psychological "meaning," but would be only the end result of a process initiated by the emotional tensions, just like peptic ulcer as the incidental end result of gastric dysfunction due to emotional disturbance, (*1*). But the muscular contractions which cause the back condition are a result of emotional tension (in this case primarily rage) and may have a symbolic meaning, (*5*) (*6*). It may be only accidental that the pain is localized in the back. Arm and leg muscles were also contracted in this case, but perhaps anatomical conditions in the extremities are not such as to result in soreness as readily as in the back. On the other hand, it may be that there are some specific psychological factors in the choice of the back. In this connection Fetterman makes a very interesting suggestion, namely, that this localization may have to do with the upright posture, implying adulthood with all its responsibilities and exertions. There was some evidence for this in the case herein mentioned as exemplified by Dream 4. Another factor which has been prominent in the five cases I have seen analytically is the sexual tension. These patients, like the young man here described, tended to drain their anger sexually also, and so when under emotional tension were in a highly excitable sexual state with orgasms during sleep, suggesting that pelvic congestion from this source might play a rôle in the back pain.

At any rate this is a fundamental psychosomatic mechanism. Particular biological impulses, in a specific constellation and status aroused by some life situation, whether they are emotionally perceived or repressed by the patient himself, give rise to dreams and stimulate specific physiological responses. These may be mostly evident during sleep, and eventuate in the specific symptom.

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## PERIODICAL LITERATURE

SAUL, LEON J.: Utilization of Early Current Dreams in Formulating Psychoanalytic Cases. *Psychoanalytic Quarterly*, 1940, vol. 9, p. 453.

By analyzing approximately the first ten dreams with their associations and reviewing them for common features in the conflict situation, rôle of the ego and type of defense, and by confining the interpretations to material that is apparent, it is possible in most cases of psychoanalysis to derive a concise, general formulation which expresses the main psychological features of the patient and analysis. This method is convenient for comparing the nuclear conflict and its status in different psychosomatic and psychoneurotic conditions. The author demonstrates this with some material of four male cases of essential hypertension, all of which showed close similarity in conflict and its status. This appeared in dreams of being caught by a man in a sexual situation with a woman, with no adequate means of escape or other solution represented. Such dreams occurred when the blood pressure was at peaks, while dreams which ended in escape or regression occurred in connection with no points in the blood pressure.

M. G.

ZIEGLER, L. H. and CASH, P. T.: Emotions and Surface Temperature. *American Journal of Psychiatry*, 1938, vol. 95, p. 676.

The problem of fever or hypothermia of unexplained origin is one of the most puzzling which the clinician must face. This report reviews the literature briefly, discusses important clinical conditions in which abnormal temperature changes occur, and reports results obtained by special methods (photoelectric continuous recording and an electromotive thermometer for taking temperatures at four successive points in rapid succession). Readings of surface temperature on 20 patients who have been subjected to some emotional strain are presented.

They state "Emotional reactions appear to have an inconstant effect on surface temperature, as Pembrey has concluded. It seems fairly well established that emotions or affects may conspire to produce surface temperature deviations, variable in duration, even to the extent of fever or outspoken hypothermia."

H. W. B.

SHILDER, P.: The Organic Background of Obsessions and Compulsions. *American Journal of Psychiatry*, 1938, vol. 94, p. 1397.

Seven cases presenting a clinical picture of obsessional neurosis are presented because definite organic signs reminiscent of epidemic encephalitis were found. The author thinks it unlikely that these are cases of epidemic encephalitis, but rather due to early traumatic toxic factors and infectious processes or to constitutional factors. He correlates the motor behavior with the psychic symptomatology, sadistic attitudes and the changed attitudes toward space. He stresses the necessity for taking organic motor factors into account, but reports good results in a majority of the cases treated. This difficult subject should be of interest to those who are interested in the physiological background of the symptoms of neuroses and psychoses.

H. W. B.

Boss, M.: Körperliches Kranksein als Folge seelischer Gleichgewichtsstörungen. Verlag Hans Huber, Bern, 1940.

Bodily Sickness as Result of Mental Disturbances; in 6 lectures, the author gives an outline of the field of psychosomatic medicine in a form understandable for the interested layman. It is extremely well done and covers the field rather completely.

M. G.

GOLDMAN, GEORGE S.: On the Differential Diagnosis of Organic and Psychogenic Disturbances. *Diseases of the Nervous System*, 1941, vol. 2, p. 23.

The diagnosis of neurosis should not be made on the basis of negative evidence alone, that is, the absence of organic pathology. Positive evidence should be found; that is, that the patient is sick emotionally. Close relationships should be established between the symptoms and the patient's emotional disturbance; in fact, the symptoms are a direct outgrowth of the emotional disturbance. The diagnosis may be tested by a form of therapeutic test. Each case should be approached as a psychosomatic problem.

M. G.

VAN BALEN, G. F.: Anorexia Nervosa and Hypophysäre Magerkeit. *Acta medica Scandinavica*, 1939, vol. 101, p. 432.

After an analysis of 82 cases (including those of von Bergman, Kylin, Wahlberg, Berkman) reported as Simmonds' Disease, the author concludes that many of these cases are misdiagnosed since simple starvation may account for all the physical findings which occur after hypophysectomy. He favors the name "anorexia nervosa" over endogenes or hypophysäre Magersucht, deplores reliance upon pituitary extracts when psychotherapy is essential. The best results are obtained in illnesses of short duration; three of his chronic cases were unresponsive to treatment. There is a bibliography of 124 articles.

H. W. B.

MCFARLAND, R. A. and GOLDSTEIN, H.: The Biochemistry of Dementia Praecox. *American Journal of Psychiatry*, 1938, vol. 95, p. 509.

For those interested in this field, this extensive review will be a useful landmark. The authors abstract 139 leading articles, emphasizing the more significant results and methods, commenting upon the pitfalls and handicaps inherent in the methods, and stress the necessary conditions for a successful study. The heterogeneity of the schizophrenias, the marked variability which "must be related to a defective homeostasis," the need for long-section serial studies over a protracted period are discussed at length.

H. W. B.

LAYMAN, JAMES W.: A Quantitative Study of Certain Changes in Schizophrenic Patients under the Influence of Sodium Amytal. *Journal of General Psychology*, 1940, vol. 22, p. 67.

Data based on the Stanford-Binet, Rorschach, five performance board tests included in various measures of intelligence, three tests of motor skills and the Bernreuter Personality Inventory were obtained from 20 schizophrenic patients receiving treatment at the Psychopathic Hospital, State University of Iowa. All subjects were receiving sodium amytal as a part of their treatment and were tested on the above battery before, during and after administration of the drug. In general, the performance under sodium amytal differed considerably from that in the other two test periods. On the Stanford-Binet (1916 Revision), M. A. and vocabulary scores are in closer agreement, the number of sub-test failures decreases and the average ratio of tests passed at each age level declines during the period of the drug influence. The number of responses and the organization scores on the Rorschach improve under the amytal, although the critical ratios are not completely reliable. Fewer moves and less time are required on the performance boards. The test of motor skills indicated somewhat improved performances. Changes on the Bernreuter were not significant although there was a tendency for lowered neurotic scores and an increase in the self-sufficiency and dominance scores. The degree of rapport obtained as a result of the sodium amytal ranged from a "moderate" degree of cooperativeness, interest and effort to those who were much more so. The fact that the various changes precede narcosis would agree with the theory that sleep itself is not necessary, but rather that the drug is anti-inhibitory in nature.

J. W. L.

MENNINGER, KARL A.: Factors in Urination and Genito-Urinary Afflictions.

*Psychoanalytic Review*, 1941, vol. 28, p. 117.

A brief review of the psychological factors in urination and in some urinary disturbances is presented, emphasizing and illustrating the component erotic, aggressive, and self-punitive elements. The question of how functional deviations lead to pathological structuralization is approached on the basis of one case illustration. The occurrence of attacks "simulating" renal colic in certain individuals of the "urethral personality type" is mentioned as a problem for further special investigation.

M. G.

GOLDSTEIN, H. and MCFARLAND, R. A.: The Biochemistry of Epilepsy. *American Journal of Psychiatry*, 1940, vol. 96, p. 771.

The authors find here few definite biochemical abnormalities, but do find a great range in variability. While the changes associated with convulsions are definite (lowered pH, increased sugar and calcium in the blood) they are not statistically reliable. Many chemical correlations are reviewed, but none seem significant in respect to etiology. This is an excellent article with thoughtful analysis about the work under discussion.

H. W. B.

JELLIFFE, SMITH ELY: The Parkinsonian Body Posture, Some Considerations on Unconscious Hostility. *The Psychoanalytic Review*, 1940, vol. 27, p. 467.

It is no longer sufficient to depend alone on drugs in the treatment of Parkinsonianism without taking into consideration the psychological factors which here play so great a rôle. Some case material is given to justify the view which sees in the specific Parkinsonian posture an involuntary attitude of defense, comparable to the stealthy approach of the boxer or wrestler to his opponent or the expectant creeping posture of so many primitive religious dance rituals. The "tone of the motor system" assumes primitive form. The extreme vacillation between love and hate lead to extremes of motor behavior. The actual trauma of the encephalitic infection had given rise to a condition of helplessness. The idea of one patient that he was bound hand and foot was an expression of this helplessness responsible for his regression to the phase of early childhood where all needs are taken care of by the environment and denial is responded to with hate—a regression in this case held in check by a feeling of guilt.

M. G.

BLANTON, SMILEY: Analytical Study of a Cure at Lourdes. *Psychoanalytic Quarterly*, 1940, vol. 9, p. 348.

The case about which the author reports was considered to be a cure by the Medical Bureau at Lourdes which consists of Doctors who have joined the organization of Our Lady of Lourdes and whose purpose it is to pass on the validity of the cures. The history was taken by the author himself: The patient became sick in 1925 when he was twenty. Tuberculosus bacilli were discovered in his sputum. He left for South Africa, recovered, again became sick in 1931 and a tuberculosis of the spine was diagnosed. 1932 he returned to Dublin in England, with abscesses in right lumbar region, left shoulder. 1935 an acute nephritis occurred and he should have been transferred to the "hospital for the dying" as a hopeless case. Instead of that he went to Lourdes, took two baths, felt a "glow of health." On the third day he got up and walked for the first time in 15 months. On the return trip his wounds healed. Two weeks later he was able to walk several miles. A year later no active signs of his disease could be found.

The author states that approximately ten or twelve such cures happen in Lourdes yearly and they cannot just be thrown aside as imaginary. Common to all these cures is the fact that they happen to people usually given up. The author offers a psychoanalytic explanation, for such cures: In the process of removing libidinal drive from the maternal love object to acceptable objects in the outer world, the individual meets many difficulties and develops both a wish for and a fear of punishment by the mother object. The sick people of Lourdes have

reached the limit of their emotional and physical capacities to adjust to the demands of their illness. They cannot any longer accept life and yet they cannot quite accept death. To understand the force of the transference which occurs at Lourdes, analysis of the mother worship is given. The primitive mother worship is strongly reinforced by the psychology of the group at Lourdes. The value of the Virgin Mother as a transference object is infinite. In the cases at Lourdes there is a quickening of the healing processes due to the emotion aroused by the transference to an all-powerful, all-loving Virgin Mother to an extent which has not yet been realized or accepted by the medical profession.

M. G.

McNeile, L. G. and Page, E. W.: The Personality Type of Patients with Toxemias of Late Pregnancy. *American Journal of the Medical Sciences*, 1939, vol. 197 p. 383.

Using the questions and method of Ayman (*Amer. J. med. Sci., 186:* 213, 1933) these obstetricians studied 97 pregnant women with some type of renal or vascular pathology and 51 normal pregnant women. They found that over 90 per cent of the patients with essential (arteriolar) hypertension stated that they were highstrung, easily excited within themselves, unusually sensitive, easily worried, unusually shy, or unusually physically active. Four other groups (preeclampsia, eclampsia, nephritis, "recurrent toxemias") did not differ markedly from the control group so that the authors believe the difference in personality to be significant. Women with essential hypertension as a complication of pregnancy give a family history of hypertension in 75 per cent of cases.

H. W. B.

## Book Reviews

Bradley, Charles: *Schizophrenia in Childhood*. The Macmillan Co., New York, 1941, 152 pp., $2.50.

The book presents a review of all the pertinent literature of schizophrenia in childhood. In various places, the author presents illustrated case material from his own observations. The well-organized discussion first deals with the concepts of Kraepelin, Bleuler, and Adolf Meyer. Until about 1925, most publications strictly followed the Kraepelinian concepts. Since 1925, the influence of Bleuler, Meyer, and the psychoanalytic school has been predominant. The incidence of schizophrenia in children is rare. Various authors do not agree on the age limit of this reaction: some including children under ten, others considering the limit as sixteen. Some authors consider only full-fledged psychotic reactions, while others include more questionable "schizoid" reactions. It has apparently been recognized that the symptomatology varies from that of the adult. Stress is laid on diminished interest in environment, regression, motility disorders, and disturbances of speech and thinking. The course may be acute, or insidiously chronic, with the disputed possibility of progressive deterioration. It has apparently been generally accepted that the four conventional types of schizophrenia as found in textbooks are not helpful in organizing the children's material. The etiological discussion does not seem to offer valuable leads. The essential points, which are brought out in the discussion of psychopathology, are the factors of constant growth or maturing of the child which influences the psychopathological reaction and the importance of recognizing the similarity of the behavior of healthy children in certain stages of their development and that of mentally ill adults. Somatic and psychological laboratory findings have revealed little of value. This seems to be due mostly to the fact that the problems under investigation have not been defined well enough. The diagnostic discussion demonstrates the difficulty of the various authors in agreeing on what is essential. The best diagnostic formulation is one which is factual and avoids bringing in disputed psychopathological concepts. Treatment, prophylaxis, and prognosis are reviewed in detail. In the final chapter, the author gives a summary which can be taken as a valuable working plan. Dr. Bradley's book, which is unique in its field, should be most helpful to any worker in child psychiatry and important to those who are investigating the problem of schizophrenia.

Oskar Diethelm

Bortz, Edward L.: *Diabetes*. F. A. Davis Co., Philadelphia, 1940, 296 pp., $2.50.

This small volume is divided into twenty short chapters dealing with various phases of diabetes, and it is intended for the physician and the layman. However the book will be more helpful to the layman as from a medical standpoint it is very brief and superficial. These features may have been necessary because of the author's desire for conciseness. The dietary tables, instruction for urinalysis and instructions for calculating diabetic and obesity diets are excellent and will prove helpful to both the layman and the physician.

Edward Tolstoi

Note: The Society for Psychotherapy & Psychopathology of New York has appointed a committee headed by Dr. Bernard Glueck to arrange for the publication of one or more of the books of the late Dr. Paul Schilder. Contributions to make such publications possible may be sent to the secretary of the committee—Frank J. Curran, M.D., 404 East 55th Street, New York City.

Louis Wender, *Secretary*
Hastings-on-Hudson, N.Y.